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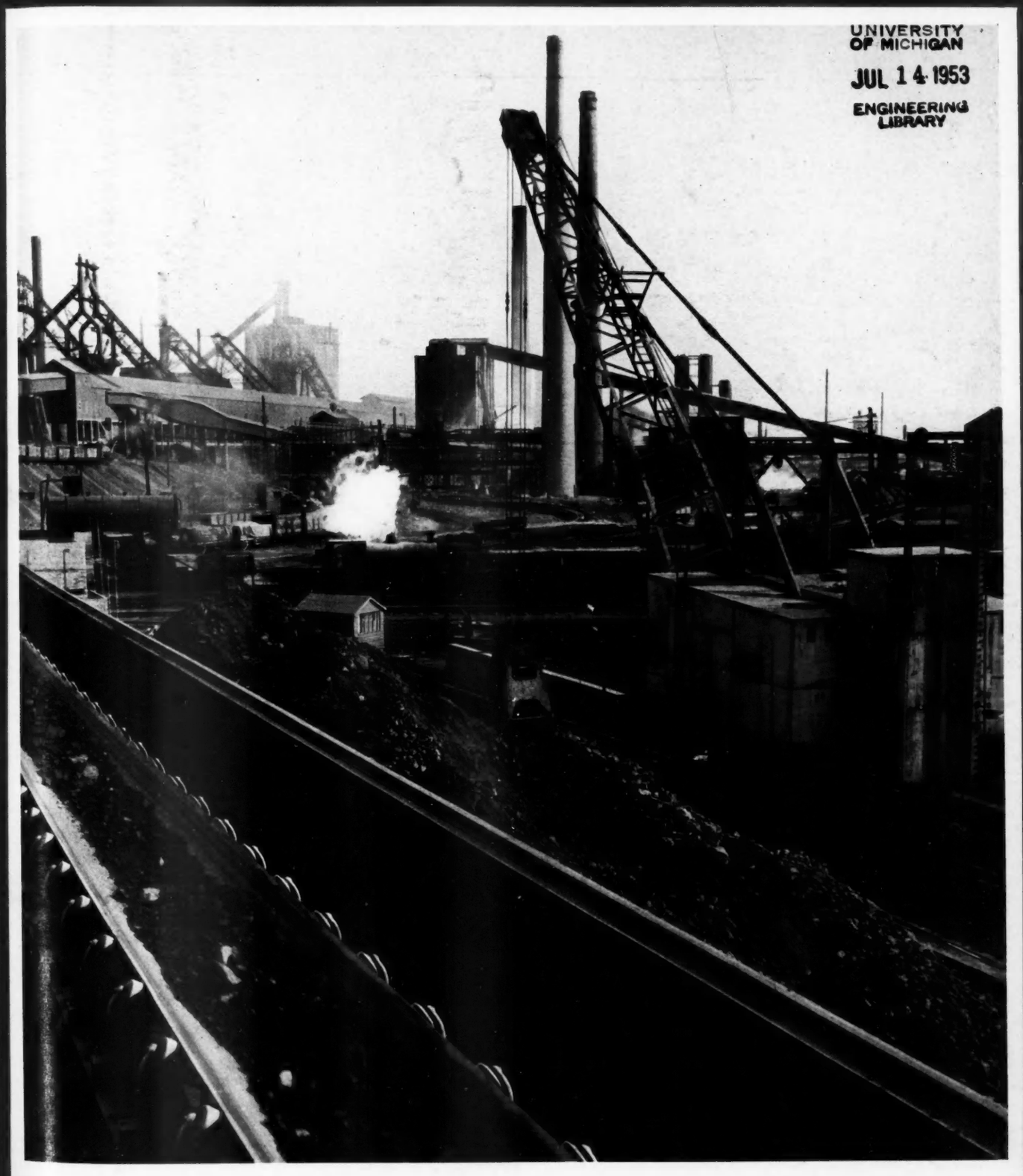

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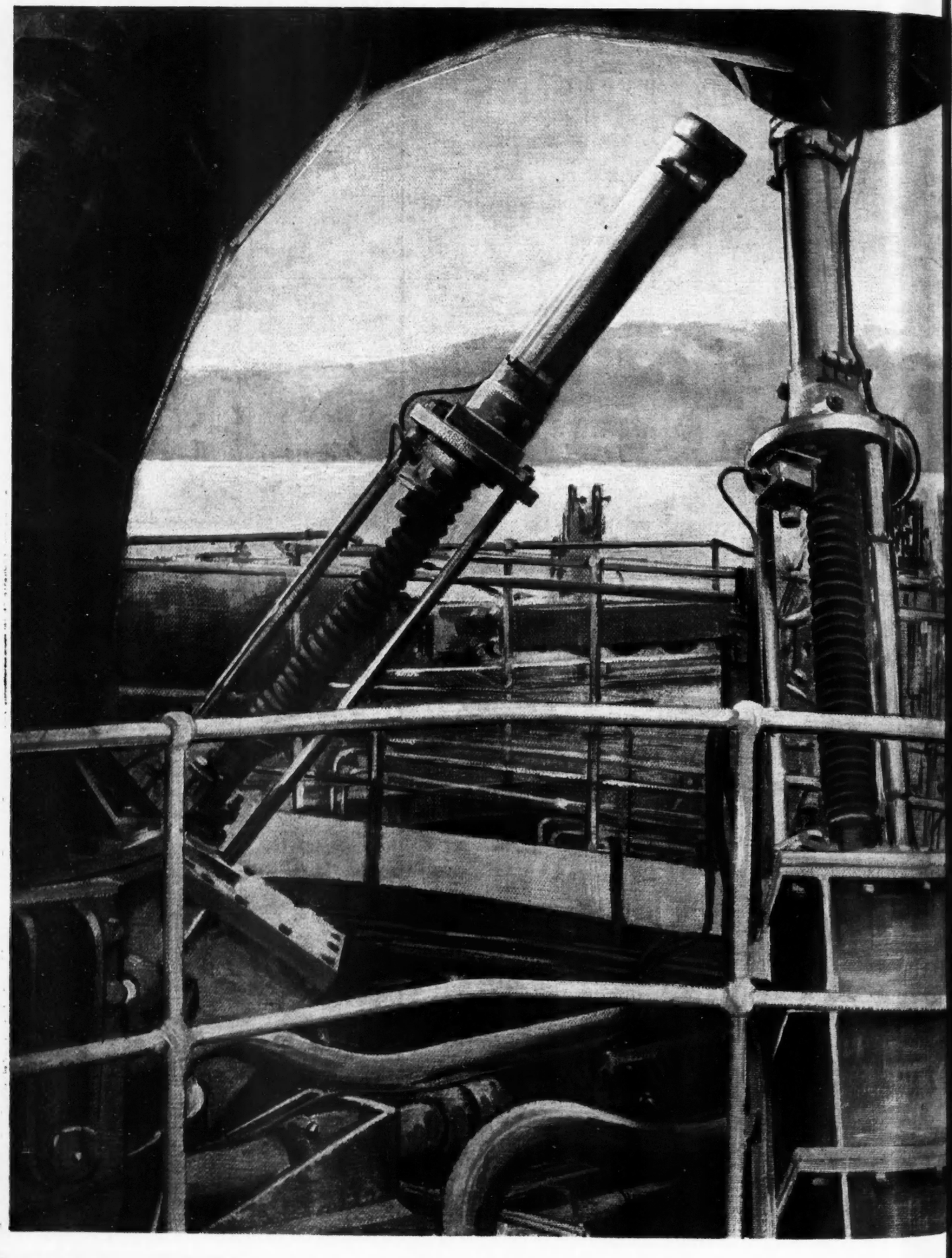

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PORTABLE TURBO-COMPRESSORS AND INDUSTRIAL GAS TURBINES.

AN interesting range of small gas turbines for aircraft and industrial applications is shortly to be produced in the United Kingdom by Blackburn and General Aircraft, Limited, Brough, East Yorkshire, under licence from Société Turbomeca, Bordes, Basse Pyrenées, France. The Turbomeca range falls into three categories—jet engines for aircraft, shaft turbines for industrial or auxiliary aircraft drives, and air compressors for industry or helicopter blade-tip drives. Initially, the Blackburn company are concentrating on the industrial machines (the Palouste air compressor and the Artouste shaft turbine), which are primarily of interest where compact machines of outstandingly light weight are required.

The jet engines, the simplest form of Turbomeca power unit, with a single turbine driving a centrifugal compressor, and an annular combustion chamber of unusual design, consist of the Piméné, developing a maximum static thrust of 220 lb. with a specific consumption of 1·1 lb. per lb. thrust per hour; the Palas, developing a maximum static thrust of 350 lb. with a specific consumption of 1·17 lb. per lb. thrust per hour; and the Marboré, developing a maximum static thrust of 883 lb. with a specific consumption of 1·15 lb. per lb. thrust per hour. The Piméné, Palas, and Marboré compressors, working to a pressure ratio of 3·9 to 1, deal, respectively, with mass flows of 4·4, 6·6 and 16·5 lb. per second, respectively. There is also a ducted fan, the Aspin II, developing a maximum static thrust of 795 lb. with a specific fuel consumption of 0·545 lb. per lb. thrust per hour.

The shaft turbines employ two turbine stages, and fall into two classes, namely, the Artouste I and II, in which both turbines are coupled to the compressor, and the Turmo I and II, in which a free turbine drives the output shaft. These latter engines are considered to be particularly suited to the propulsion of marine craft and military tanks. The Artouste I and Turmo I (about 270 h.p. maximum) have the same type of compressor as the Piméné jet engine, and the Artouste II and the Turmo II (about 390 h.p. maximum) as the Palas jet engine.

The air-compressor units employ oversize compressors; two-thirds of the air mass flow is absorbed by a two-stage fixed turbine in driving the compressor. The Pimedon, with a maximum output of 82 lb. of air per minute at 41·2 lb. per square inch (gauge) and 15 deg. C., is fitted with a Piméné-type compressor. The Palouste, which will be the first Blackburn-built unit available, with a maximum delivery of 139 lb. of air per minute at 41·2 lb. per square inch (gauge) and 15 deg. C., comprises a Palas compressor coupled to an Artouste I driving turbine.

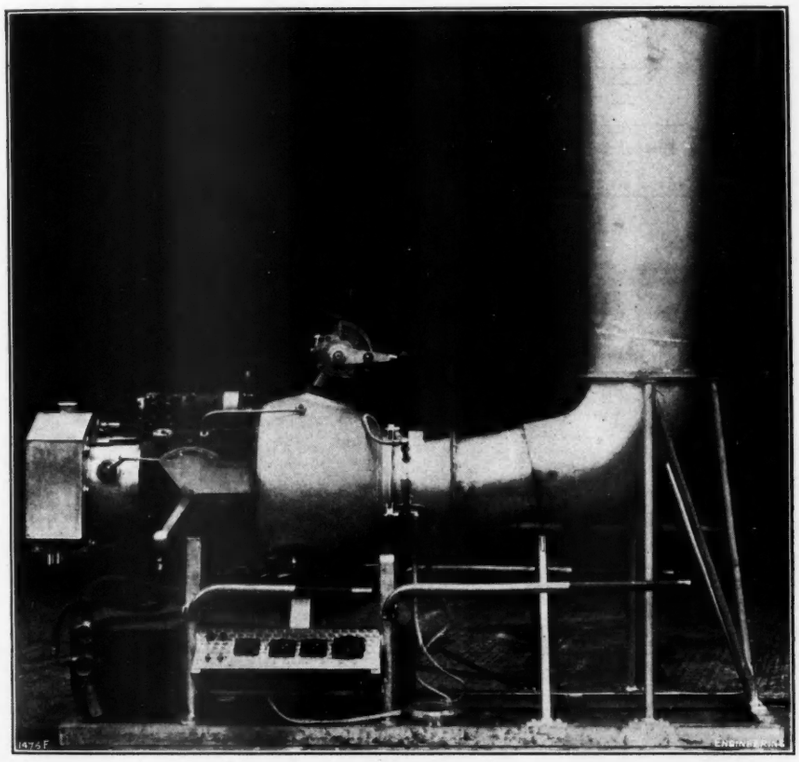


FIG. 1. "PALOUSTE" TURBO-COMPRESSOR ON PORTABLE TEST STAND.

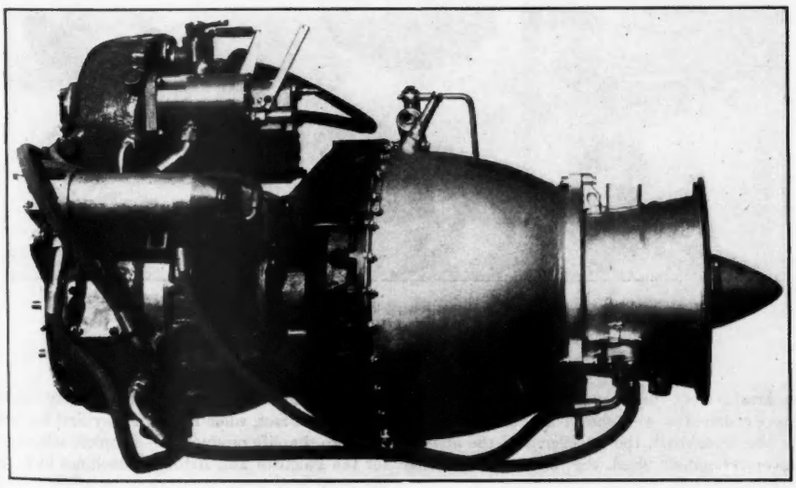


FIG. 2. "ARTOUSTE I" GAS TURBINE.

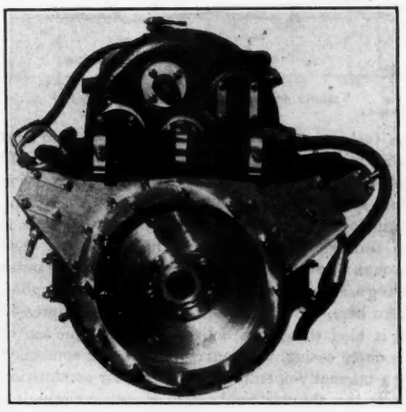


FIG. 3. "ARTOUSTE I" GAS TURBINE, SHOWING DRIVE TAKE-OFF.

Société Turbomeca recommend the adoption of a period of 300 hours between overhauls. On the basis of acceptance tests, still in progress, on the Palouste air compressor, however, the Blackburn company are confident that this overhaul period can be considerably increased. The Palouste has been stripped and examined after 150 hours, 300 hours, and 600 hours of running, and no replacements have been found necessary. The engines will run on kerosine, petrol or Diesel oil, but at present a small auxiliary supply of petrol is required for starting. The noise developed by an unsilenced unit is considerable, but the Blackburn company state that adequate silencing equipment is available.

The Palouste air compressor, on test at Brough, is illustrated in Fig. 1, and a part-sectional drawing is given in Fig. 9, on Plate XXV. The overall dimensions are: length 41·7 in., width 18·66 in., and height 19·67 in., and, weighing only 187·5 lb., the unit can easily be handled by two men. At maximum output, which, as already mentioned, is 139 lb. of air per minute at 41·2 lb. per square inch, the unit consumes 275 lb. of fuel per hour. Performance curves for the Palouste are given in Figs. 4 and 5, on page 802.

The unusual feature of all the Turbomeca machines lies in the fuel-injector and combustion-chamber arrangement, designed to give good mixing. Reference to Fig. 9 shows that the fuel feed, metered by a gear-type pump and centrifugal regulator, passes by way of a labyrinth seal, through the hollow compressor shaft to a rotary fuel-distributor disc integral with the shaft. Fuel is injected through peripheral holes in the disc into the annular combustion chamber. The air enters the compressor through an annular intake formed between the intake casing and the central stalk which houses

PORTABLE TURBO-COMPRESSORS AND GAS TURBINES.

BLACKBURN AND GENERAL AIRCRAFT, LIMITED, BROUGH, YORKSHIRE.

Fig. 4. "PALOUSTE" AIR COMPRESSOR.

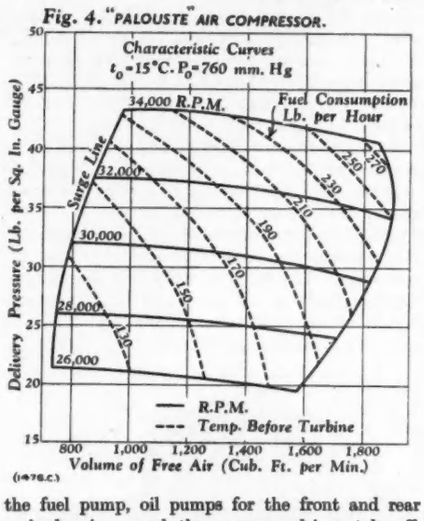


Fig. 5. "PALOUSTE" AIR COMPRESSOR.

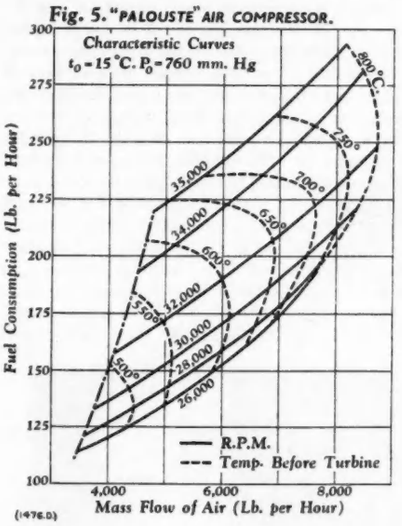
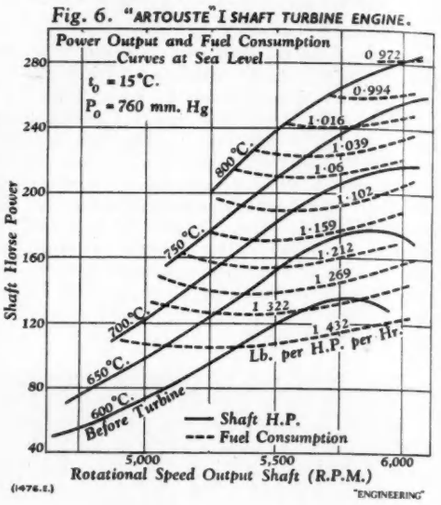


Fig. 6. "ARTOUSTE" I SHAFT TURBINE ENGINE.



the fuel pump, oil pumps for the front and rear main bearings, and the accessory-drives take-off. The drive for these components is by an extension shaft splined to the compressor shaft. After being compressed in the centrifugal impeller, the air is led through a row of radial diffuser vanes, then through a row of axial diffuser vanes, into the outer casing surrounding the annular combustion chamber. From here, in the Palouste, part of the compressed air is bled through a delivery duct at the top of the outer casing, the delivery flow being controlled by a manually-operated valve. Air for combustion enters the annular combustion chamber through a series of holes in the wall of the chamber and flows forward to mix with fuel injected by the rotary fuel distributor. Secondary air enters through a further series of holes and pipes in the chamber. The gases then flow through the first-stage nozzle guide vanes and through the two axial-flow turbine stages. The rear bearing is air cooled, the air being induced by the pumping action due to radial slots machined in the front face of the flanged stub shaft.

Some of the components are illustrated in Figs. 7 and 8, and in Figs. 10 and 11, on Plate XXV. In Fig. 7 the 2nd-stage and 1st-stage nozzle rings are shown in the foreground. The compressor, it will be observed, is of two-piece construction, in aluminium alloy. The two turbine wheels, integral with the blades, are machined from the solid in an alloy containing 36 per cent. nickel, 15 per cent. chromium, 20 per cent. cobalt, and the remainder iron. The combustion chamber is in a material similar in composition to Nimonic 75. The forward casing of the air intake comprises an oil tank. Two igniter plugs and a booster coil are provided for starting. Normally an electric starter motor is fitted, but there is provision also for starting the compressor by compressed air, and the Blackburn company are considering developing hand-starting gear.

The Artouste I shaft turbine, shown in Figs. 2 and 3, on page 801, is expected to undergo proving tests shortly at the National Gas Turbine Establishment. Its general arrangement is shown in Fig. 12, on Plate XXV. This engine has an overall length of 36·6 in., a width of 20 in., and a height of 23·2 in., and weighs 183 lb. It develops a maximum shaft power, at 35,000 compressor r.p.m., of 276 h.p., with a specific fuel consumption of 0·96 lb. per horse-power per hour. The maximum continuous rating, at 34,000 compressor r.p.m., is 226 h.p., with a specific fuel consumption of 1·02 lb. per horse-power per hour. Performance curves for the Artouste I are reproduced in Fig. 6. The output shaft at the forward end, is driven through spur reduction gearing, giving a maximum output speed of 6,000 r.p.m.

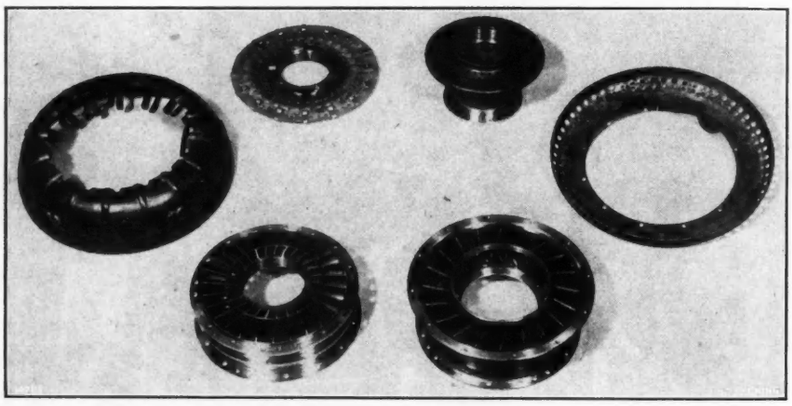
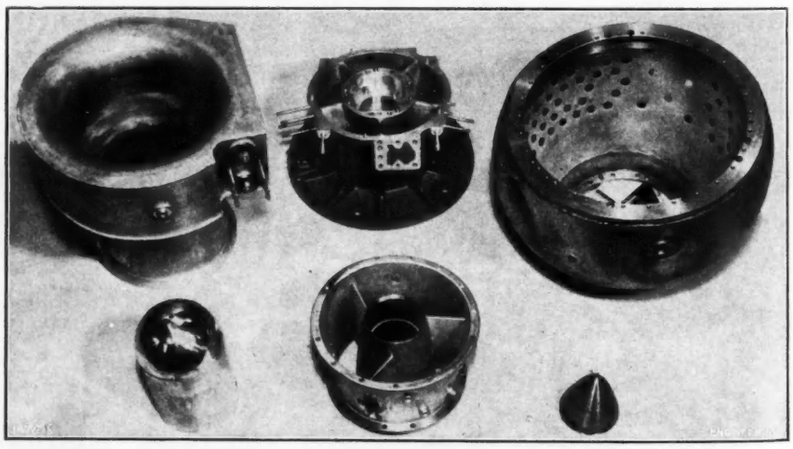


FIG. 7. "PALOUSTE" TURBO-COMPRESSOR PARTS.



Air-intake casing, with oil tank. Nose cap. | Compressor casing, front. Exhaust diffuser. | Centre casing. Exhaust-diffuser rear cap.

FIG. 8. "PALOUSTE" TURBO-COMPRESSOR CASINGS.

The arrangement of the reduction gearing and accessory drives is well shown in Fig. 12. Apart from the drive shaft, the impeller, and the absence of a compressed-air bleed, the Artouste I is similar in principle to the Palouste.

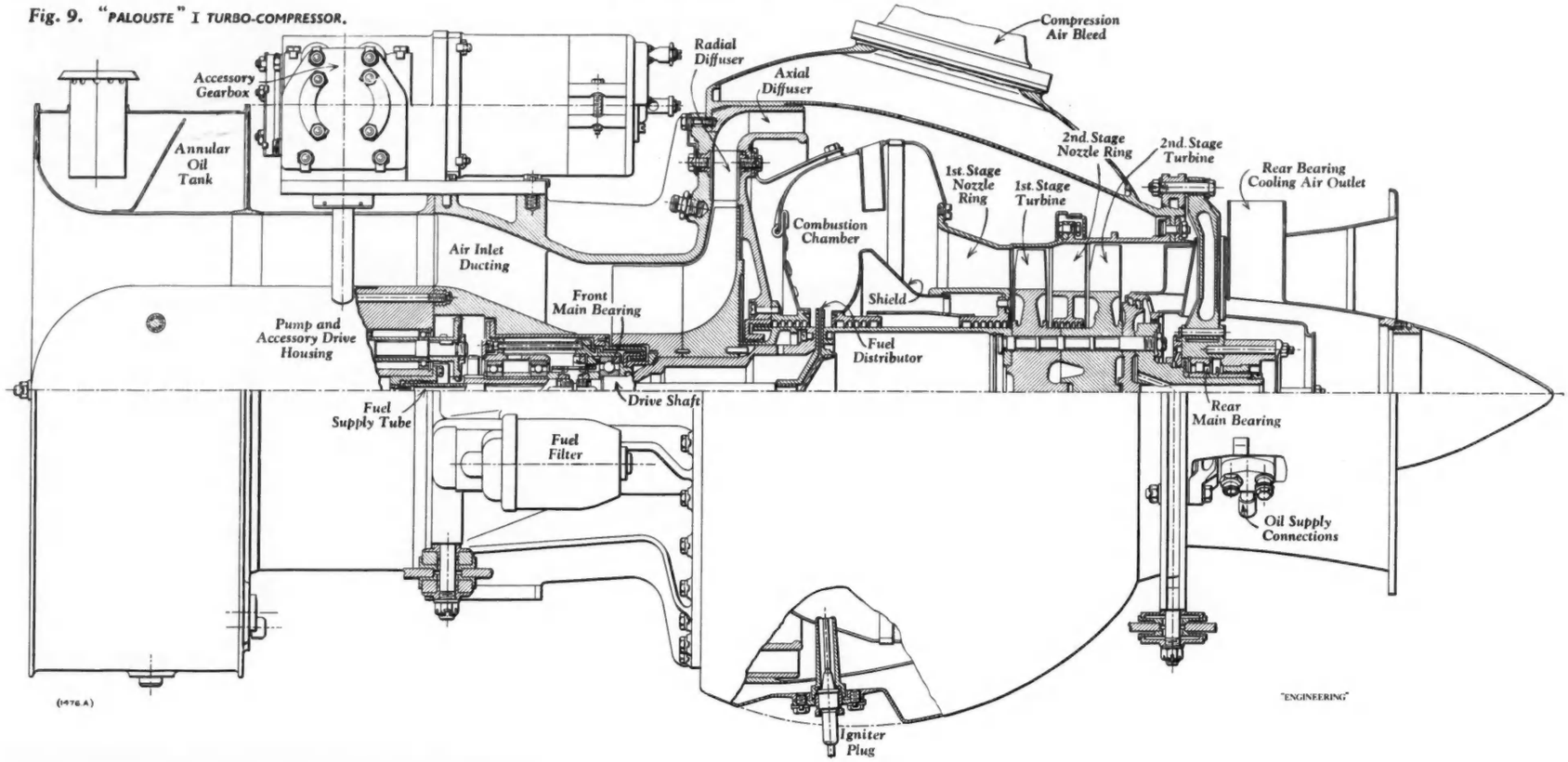
Although production from raw materials is not due to commence in the Blackburn factory for some months—in fact, some redesign may first be undertaken to simplify production—complete sets of parts for the Palouste and Artouste machines have been imported from France, and these units are therefore available to-day.

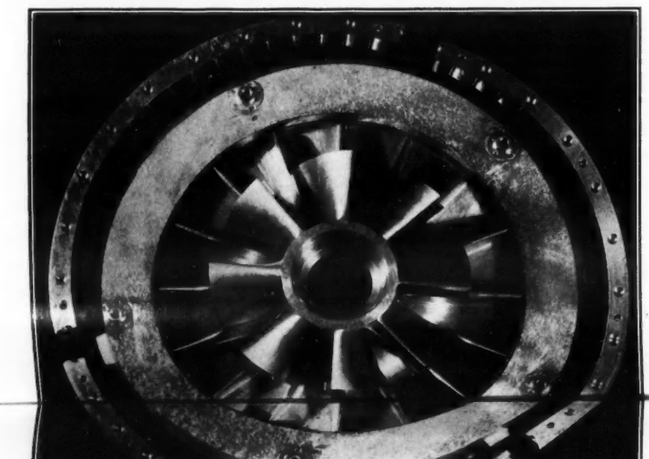
PORTABLE TURBO-COMPRESSORS AND GAS TURBINES.

BLACKBURN AND GENERAL AIRCRAFT, LIMITED, BROUGH.

(*For Description, see Page* 801.)

Fig. 9. "PALOUSTE" I TURBO-COMPRESSOR.





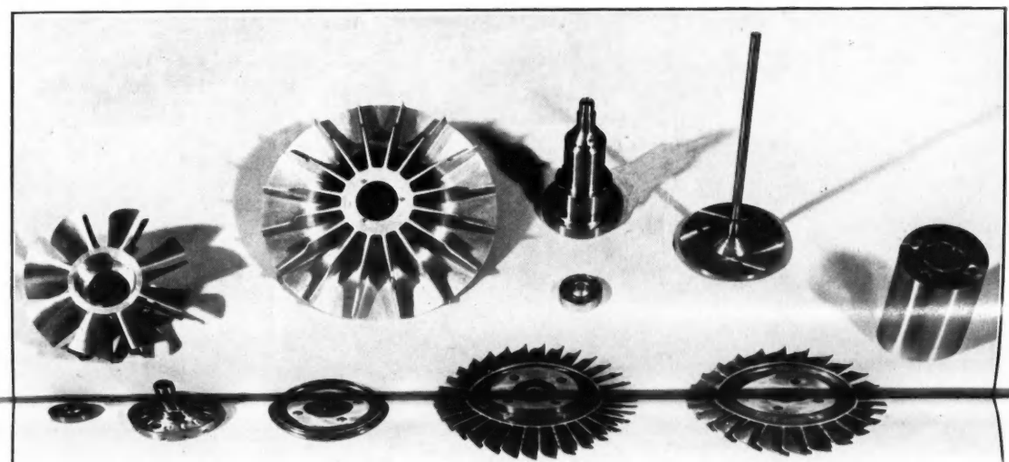


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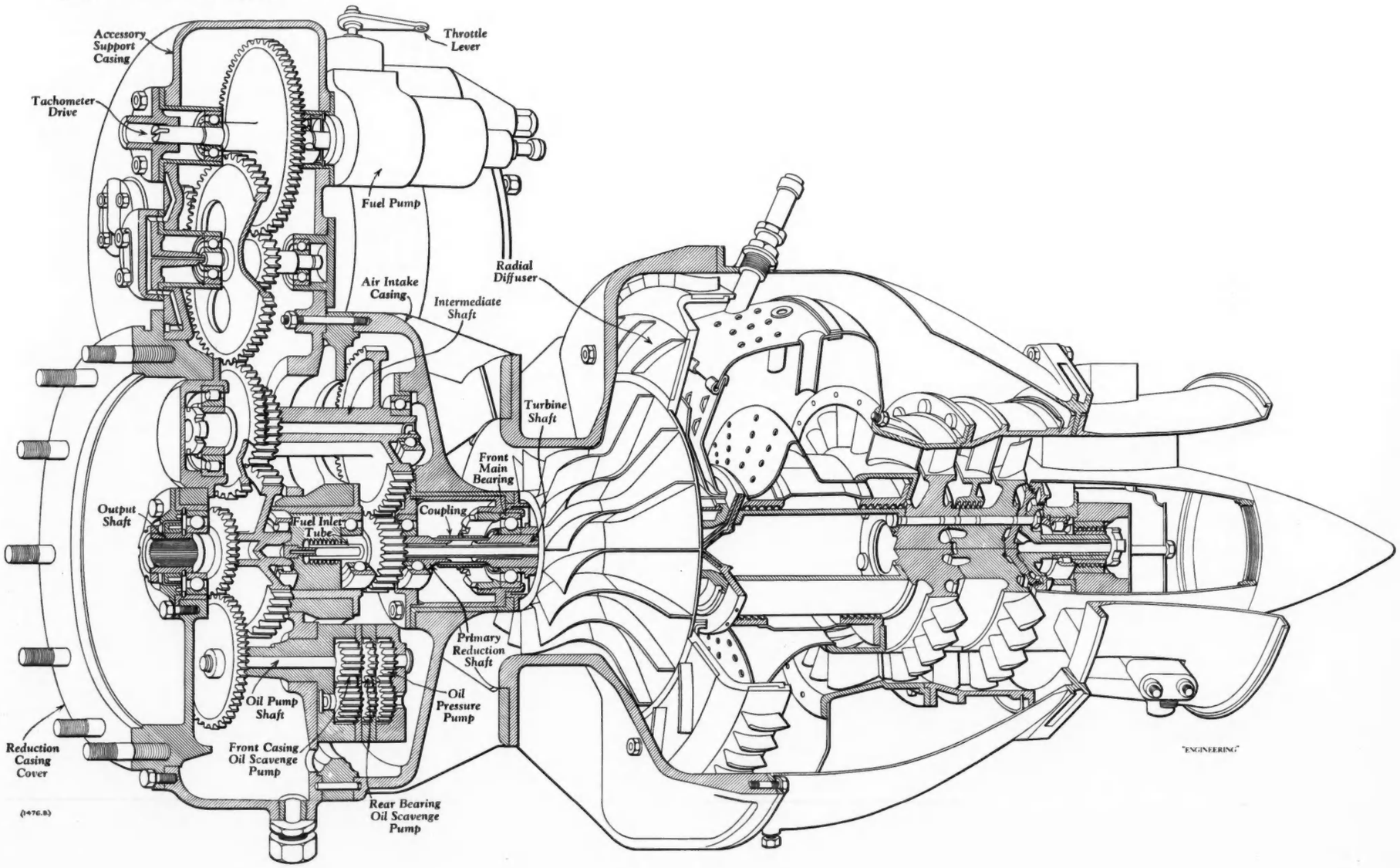
FIG. 10. "PALOUSTE" COMPRESSOR ASSEMBLY, WITH RADIAL AND AXIAL DIFFUSERS.

Air-intake guide vanes. Impeller. Drive shaft, front, and front bearing. Injector wheel. Drive shaft, centre.
Rear bearing. Drive shaft, rear. Equilibrating piston. 2nd-stage turbine. 1st-stage turbine.

FIG. 11. "PALOUSTE" TURBO-COMPRESSOR COMPONENTS.

Fig. 12. "ARTOUSTE" I GAS TURBINE.



LITERATURE.

Calculus of Variations, with Applications to Physics and Engineering.

By PROFESSOR ROBERT WEINSTOCK. International Series in Pure and Applied Mathematics. McGraw-Hill Book Company, Incorporated, 330, West 42nd-street, New York 36, U.S.A. [Price 6·50 dols.]; McGraw-Hill Publishing Company, Limited, McGraw-Hill House, 95, Farringdon-street, London, E.C.4. [Price 55*s.* 6*d.*]

WHOLE regions of physics and engineering are deducible from stationary principles, such as Fermat's principle of least time in optics or Maupertius' principle of least action in mechanics, and the calculus of variations, which has developed out of them, constitutes one of the most pregnant and powerful extensions of the infinitesimal calculus. The aim of the present volume is twofold; in the first place to provide an introduction to the ideas and techniques of the calculus of variations and, in the second place, to illustrate its application to selected topics in physics and engineering.

The typical problem of the calculus of variations is that of geodesics—the determination of the longest or shortest lines which can be drawn on a given closed surface between one point and another or from one curve to another. In the calculus of variations the object of investigation is not the increment in the value of a definite function resulting from an infinitesimal change in the value of its subject variable, as in the infinitesimal calculus, but a variation in the value of a definite integral consequent upon an alteration in the form of the function included under the integral sign. To distinguish such a variation from an ordinary differential, Lagrange introduced the symbol δ. Professor Weinstock, however, condemns the "δ method" as vague and mechanical, which are sufficiently good reasons for avoiding its use, particularly as the method he replaces it by is less liable to cause confusion. Certain mathematical results are collected together for reference at the outset to avoid interrupting the main exposition, which begins at Chapter III. In this the general method of attack is developed, the Euler-Lagrange equation derived, J. Bernoulli's famous problem of the brachistochrone, or curve of quickest descent under gravity between a pair of points in a vertical plane but not in a vertical line, considered, and the treatment of problems involving several dependent variables is explained.

A chapter devoted to isoperimetric problems, in which curves of fixed length have to be found satisfying certain maximum or miniumum properties, is followed by a brief account of Fermat's principle. Chapter VI summarises the essential methods of classical particle dynamics, Lagrange's equations of motion, the Hamilton-Jacobi differential equation and the principle of least action. The next chapter begins with the procedure for the extremisation of a double integral, then considers the transition from a discrete set of mass particles to a continuous mass distribution, as exemplified in the vibrating string, and the Ritz method of approximating to its eigenvalues and eigenfunctions subject to various imposed end conditions. After a discussion of the Sturm-Liouville eigenvalue-eigenfunction problem and two singular cases involving Laguerre polynomials and Bessel functions, the extremisation of a multiple integral leads to a detailed investigation of the vibrating membrane and its associated eigen values. Chapter X, on the theory of elasticity, will be of special interest to engineers. Consideration is limited to cases governed by Hooke's law and, in treating the transverse vibration of bars, warping of the cross-section is ignored. Other topics discussed are the transverse vibrations of thin plates and the Ritz method of approximating to the eigenvalues of a rectangular plate subject to various edge constraints.

The chapter on quantum mechanics provides an attractive introduction to the equation of Schrödinger and the physical interpretation of his wave function together with its extension to several particles and the Hartree model of the many-electron atom. In equation 10, on page 265, Δ^2 should read ∇^2. In the concluding chapter there is a return to classical physics with a short discussion on capacitance problems in electrostatics. The numerous exercises illustrating and extending results given in the text are supplied with helpful hints and an occasional warning, as on page 64, against "a certain quick, thoughtless attack . . . and a second, swindling approach . . ."

As the chief purpose of the author has been to illustrate applications of the calculus of variations outside the realm of pure mathematics problems of sufficiency and existence have been deliberately left aside. However, neither these intricate matters nor further applications of the calculus of variations should present any insuperable difficulties to the reader who has mastered the contents of this excellent text-book.

La Commande Électromagnétique et Électronique des Machines-Outils.

By Professor A. FOUILLÉ and J. CANUEL. Dunod, 92, Rue Bonaparte, Paris, 6e. [Price 3,250 francs.]

THE first part of this work is particularly concerned with the selection of the appropriate type and size of electric motors for driving machine tools and with the requisite control circuits. The special features of motor design developed to satisfy the requirements of drives to produce reciprocating movements are described in Chapter III. Fractional horse-power motors of the single-phase, repulsion and universal types are treated in Chapter IV, and the problems of continuous and discontinuous speed regulation on both direct-current and alternating-current power supplies are considered in the following chapter.

The second part deals at length with the electromagnetic control of machine tools. Under the heading of "choice of motor," consideration is given to power requirements, starters, braking devices, reversing gear, overload protection equipment, and anti-vibration mountings. Following this is a chapter devoted to hand and automatic switchgear and various cut-out mechanisms. This part also includes a number of circuit diagrams for controls.

The third part, which is concerned with the electronic regulation and control of machine tools, is of considerable interest. It opens with an account of the various types of electron tubes, including vacuum and gas-filled diodes and triodes, mercury-arc rectifiers of the pool type, voltage-regulating tubes and thyratron control circuits. Chapter X provides a general introduction to closed control systems, or servo mechanisms, with notes on precision, stability and methods of minimising overshooting and hunting. Servo systems employing electronic components are dealt with first, after which those embodying magnetic amplifiers, amplidynes and rotorols are described. It may be noted that, on page 242, the potentiometers K_1, K_2, referred to in the text, are marked H_1, H_2 on the accompanying Fig. 303. Special conditions encountered in woodworking machinery and portable tools are briefly discussed. Fuller consideration might well have been given to photo-electric cells and other light-sensitive devices.

Finally, a number of standard commercial control and regulating devices incorporated in representative machine tools are described and illustrated. Short lists of selected references are given at the ends of the chapters and the main conclusions are summarised in a number of useful tables. There is a fairly full table of contents, but no general index.

POWER JETS' GAS-TURBINE PATENTS.—XI.*

THE GAS-TURBINE IN INDUSTRY.

THE title of this section may be, to some extent, misleading; in so far as the gas turbine is to be considered purely as a prime mover, many of the earlier sections have described inventions which are important contributions toward the development of gas-turbine plant suitable for use in industry. The present section deals mainly with patents relating to special applications of the gas turbine, in which the turning of an output shaft is not its only function—perhaps not even its primary function. At the present time, the Power Jets' consultancy team is much concerned with the consideration of uses of the gas turbine as an integral part of some process, for example, of a process in which there is a requirement for a continuous supply of high-pressure air or gas at elevated temperature, for efficient utilisation of waste heat, or for the maintenance of predetermined conditions of temperature or humidity. The simple title "Process Gas Turbines" would, however, also have been misleading, for some of the patents reviewed are concerned, as will appear, with the use of special fuels likely to arise only in industrial contexts; moreover, it is not possible at this stage to disclose very much about pending patent applications relating to pure "process" gas turbines.

Turning to the patents to be reviewed, the first is No. 588,098 which concerns an early (1944) proposal for improving the overall efficiency of a compound-cycle gas-turbine plant by the introduction of a steam cycle. The scheme is illustrated by Fig. 1, on page 804, in which the gas-turbine plant is represented as comprising low-pressure and high-pressure compressors 1 and 3 driven respectively by low-pressure and high-pressure gas turbines 2 and 4, an intercooler being provided at 7. The exhaust gases from the low-pressure gas turbine pass through the jacket of a waste-heat boiler 15, to be exhausted at 18. The feed water for the boiler forms the cooling water for the intercooler, being thereby pre-heated, and the steam generated in the boiler passes, by way of a steam separator 20, to a steam turbine 22 mounted on the shaft of the low-pressure rotor.

As the result of an arrangement between the two companies, Power Jets is able to assist in the negotiation of licences under certain patents of the Oerlikon Engineering Company, of Zürich, Switzerland, as well as of agreements for the supply of technology and other services by the Swiss company. It would not be appropriate to review, in the present series, all the patents involved in this arrangement but one block of them does merit general mention in this particular section: this block is concerned with fuel-saving cycles of the kinds known as "steam-air" and "steam-gas," respectively. Examples of these two cycles are illustrated by Figs. 2 and 3, page 804. The explanation of the references in Figs. 2 and 3 is as follows: *a* steam boiler, *b* back-pressure turbine, *c* air turbine, *d* compressor, *e* generator, *f* starter motor, *g* heat-exchanger, *h* air pre-heater, *k* economiser, *l* heat-consumer, *m* gas turbine and *n* combustion chamber.

By an arrangement concluded since earlier sections of this series went to press, Power Jets has acquired exclusive licensing rights under several patents belonging to the well-known Swedish engineer, Mr. Alf Lysholm. Most of these patents relate to subject matter falling within the province of earlier sections; No. 595,807, however, falls within the field with which the present section is concerned. This patent, illustrated by Fig. 4, page 804, relates to open-cycle gas-turbine plant in which only heated air, uncontaminated by products of com-

* This part concludes the series. Part X appeared on page 773, *ante*.

bustion, passes through the turbines. In the particular arrangement illustrated, an electric generator 16 is mounted on a shaft which provides driving connection between high-, medium- and low-pressure turbines 10, 12 and 14 on the one hand and high-, medium- and paralleled low-pressure compressors 20, 22, 24 and 26 on the other hand. In normal, full-load operation, air from the high-pressure compressor 20 passes through the cold side of a recuperative heat exchanger 70 to a heating coil 60 and thence to tubes 42 arranged in the radiant-heat section of an air-heater 30; the heated air then passes through the three turbines, being subject to intermediate re-heating by passage through re-heat tubes 48 and 54, situated in the heater between the previously mentioned tubes 42 and 60. The exhaust from the low-pressure turbine 14 is divided into two portions, of which one passes (as combustion-supporting gas) to the combustion system of the air-heater by way of the duct 94; the other portion is then again sub-divided so that a proportion, depending upon the setting of a flap-valve 90, is fed (also as combustion-supporting gas) to the burner 36 of the air heater, being previously re-heated by passage through the matrix of a regenerative heat exchanger 66. The diagrammatic drawing indicates inter-coolers at 164 and 166 and there are also shown various automatic control devices for adapting the plant to various load conditions; these devices include means for varying the supply of solid fuel by way of the duct 38, for by-passing one or both of the low-pressure stages of compression, for cutting out one or both of the inter-stage re-heat operations and for varying the amounts of turbine exhaust passing to the combustion system of the air-heater by way of the ducts 92 and 94, respectively.

Returning to patents of British origin, No. 638,696 is one of the very few in the Power Jets' holding which is concerned specifically with closed-cycle plant. It is well known that plant operating on such a cycle may be controlled by varying the pressure level of the working fluid and thus the mass of fluid flowing in the cycle; this is normally done by discharging some of the fluid from the system or (to increase the pressure level) by topping up with fluid from a reservoir in which it is maintained under pressure. The invention seeks to avoid the use of pressure-filled reservoirs by employing the atmosphere as a "source" as well as a "sink"; to this end, it is arranged that the maximum cycle pressure is always above that of the atmosphere and the minimum pressure always sub-atmospheric. A typical circuit is shown in Fig. 5, opposite, in which references 8 and 9 indicate valves interposed respectively between the pre-cooler 7 and the compressor 2 and between the compressor and the pre-heater 5; when either of these valves is opened, it places the relevant portion of the circuit into communication with atmosphere. It is suggested that the valves should be under the control of a governor 12, driven by the rotor shaft. Since the addition of air to the circuit to meet an increase of load must be effected in the lowest pressure region by way of the valve 9, there must inevitably be a time lag before the additional air can be compressed to cycle pressure in the compressor and caused to have effect upon the turbine 1; far from assisting in the immediate acceleration of the rotor, therefore, the added working fluid acts initially as a brake. To meet this situation, a control indicated by the dotted line 18 is provided between the governor and the air-heater fuel valve 13 to increase the fuel supply temporarily by over-riding the normal control effected by a temperature-sensitive device 14. When, in response to a reduction in load, the governor causes opening of the valve 8 to release working fluid to atmosphere, no equivalent temporary expedient is required.

Patent No. 663,862 is concerned with the provision of an economical process for drying or

POWER JETS' GAS-TURBINE PATENTS.

Fig. 1.

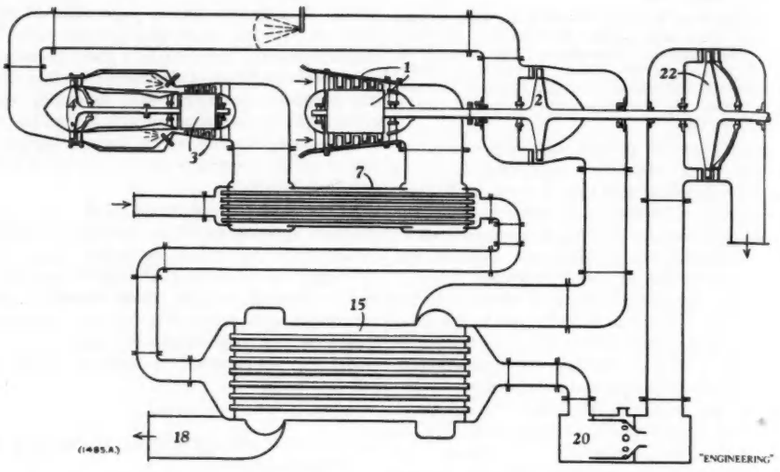


Fig. 2. Back-Pressure and Steam-Air Plant

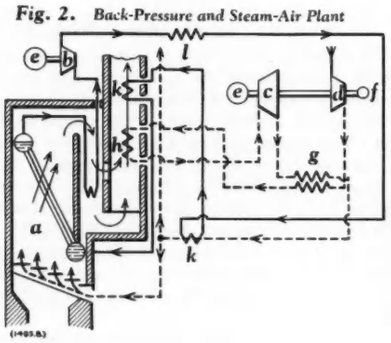


Fig. 3. Back-Pressure and Steam-Gas Plant

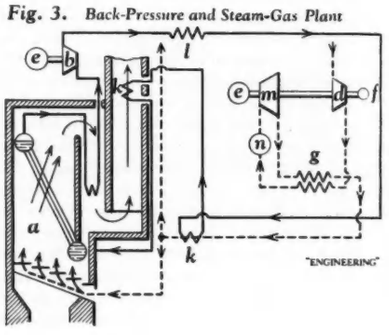
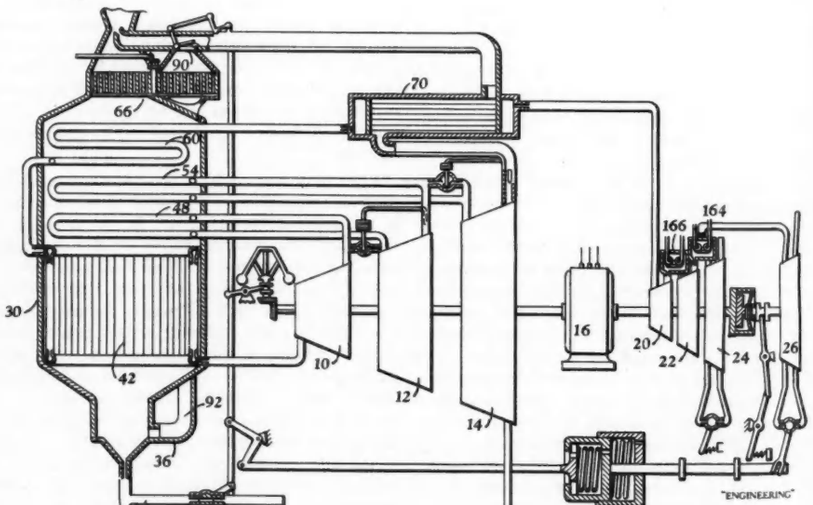


Fig. 4.



vaporising material (for example, grass or a granular material) which is not capable of sustaining a satisfactory convective circulation. Apparatus for carrying out the process is illustrated by Fig. 6, opposite, in which are represented a drying chamber 1, a circulating fan 4, a compressor 7, a heater 9 and a condenser 8. The material to be dried is placed in the chamber 1 and is initially heated by air which has been heated in the heater 9 and is circulated by the fan 4. Steam produced in the drying chamber is extracted by the fan operating in conjunction with the compressor, some of the steam being recirculated by way of the heater and part being compressed by the compressor and discharged by way of the condenser; the steam which is recirculated passes through the condenser, which thus acts as a heat exchanger between the two steam flows, the compressed steam giving up latent heat to the steam returning to the chamber. After initial heating up, the heat supplied during

POWER JETS' GAS-TURBINE PATENTS.

Fig. 5.

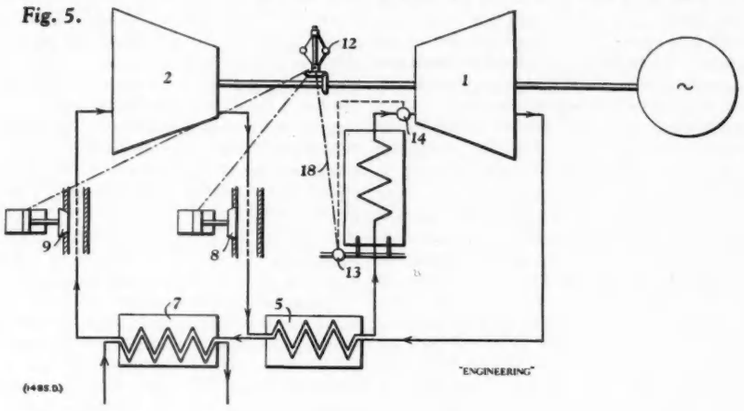


Fig. 6.

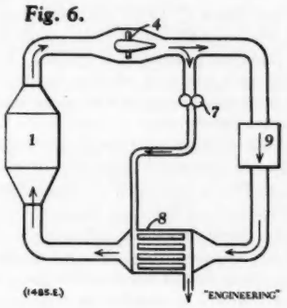


Fig. 7.

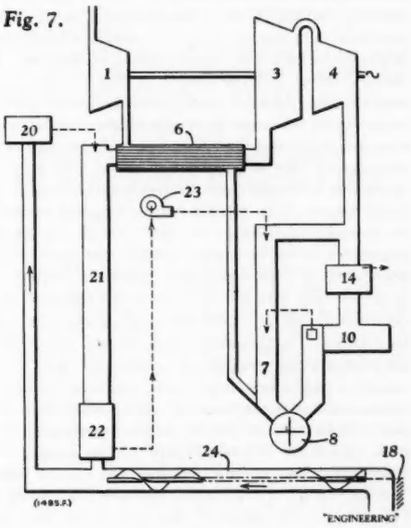


Fig. 8.

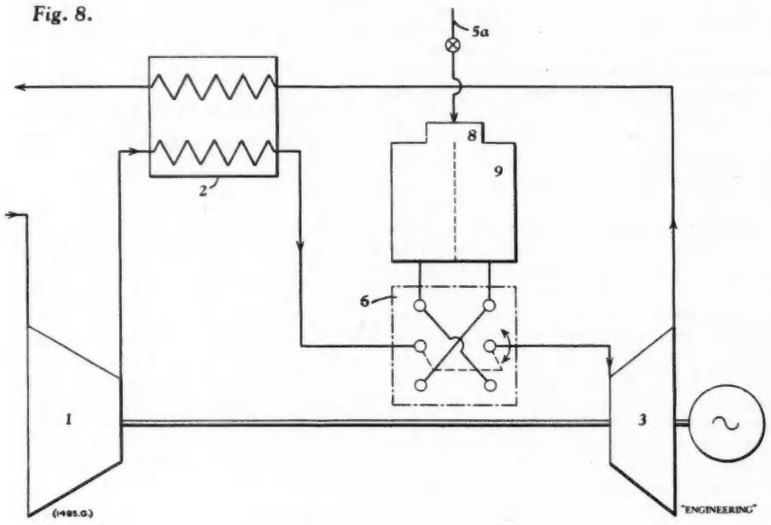


Fig. 9.

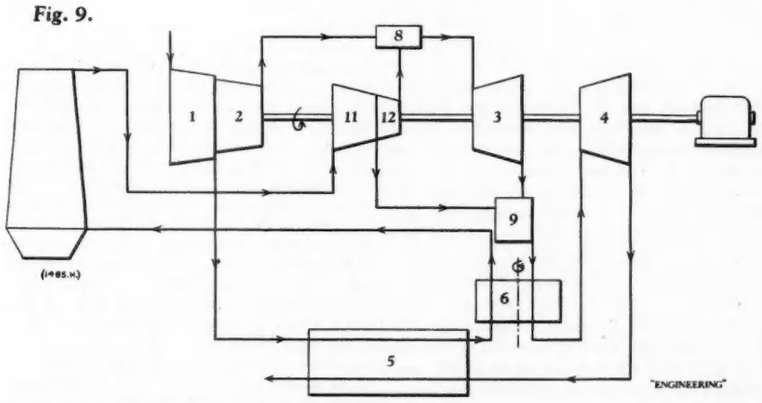


Fig. 10.

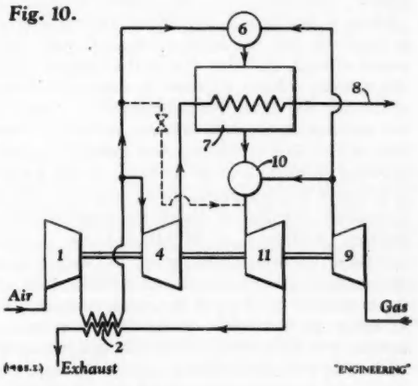
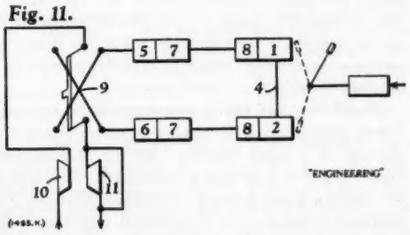


Fig. 11.



compression may be sufficient to make the process self-sustaining, the supply of fuel to the heater being discontinued. As the process proceeds, the vapour space in the chamber becomes filled with dry saturated steam, and the steam supplied from the condenser-cum-heat exchanger in a superheated condition evaporates more moisture from the charge, losing heat in the process until it again reaches the saturation temperature. Since the charge in the chamber is in an atmosphere of steam, it may require some final drying after discharge; if a gas turbine or other heat engine is used to drive the compressor, its exhaust heat may perhaps be used to effect the final drying in an economical manner.

Patent No. 666,692 is of some topical interest in view of current activity directed to the burning of peat in gas turbines. The invention is based upon the realisation that the use of a solid fuel, such as peat, which has a high water content facilitates the attainment of benefits which had previously been obtained by injection, at specific points in a gas-turbine cycle, of water in practically prohibitive quantities. Plant in accordance with the invention is illustrated by Fig. 7, in which will be recognised certain components of a conventional open-cycle gas-turbine plant, namely, compressor 1, heat exchanger 6, compressor-driving turbine 3 and power turbine 4. Instead, however, of passing in the conventional manner direct from heat exchanger to combustion chamber, the air passes first to a drier 7, at the outlet of which operates a hammer mill 8, Peat received from the drier is pulverised by the mill and passed to a cyclone combustion chamber 10, whence the products of combustion pass to an ash separator 14 and then divide into two streams, of which one is recirculated to the drier 7 and the other passes through the turbines and heat exchanger and thence, through a pre-drying chamber 21 and peat separator 22, to a chamber 24, where it pre-heats raw

peat which has been excavated from the site, indicated at 18. From the pre-heating chamber 24, the peat passes to a press 20 for reducing water content and thence by way of the pre-drying chamber 21, the separator 22 and a peat pump 23 to the drying chamber 7 mentioned earlier. The water remaining with the peat when it enters the combustion system is expanded through the turbine in the form of steam.

There are pending at the present time several patent applications which originated in the Ministry of Fuel and Power and which concern improvements or modifications of the peat-burning system just described. None of these applications has yet reached the stage at which detailed disclosure can be made: some details can, however, be given of an invention covered by another pending application and involved in the Ministry's experiments in the burning of methane in gas-turbine plant. The intention is to use, as fuel, the upcast air from coal mines, in which the concentration of methane is usually below 1·0 per cent.; a fuel of such low calorific value does not readily burn in the conditions normally to be found in a gas-turbine combustion chamber, but it has been found possible to achieve a satisfactory rate of combustion if the fuel is pre-heated to a temperature in the neighbourhood of 1,000 deg. C. The gases resulting from combustion under such conditions are much too hot for direct admission to an orthodox turbine and apparatus, illustrated by Fig. 8, page 805, has been evolved to facilitate both the pre-heating of the fuel and the conditioning of the combustion gases for entry to the turbine. In the arrangement shown, the upcast air (methane/air mixture) is compressed in a compressor 1 and passes through the cold side of a heat-exchanger 2 to a change-over valve 6 which may be adjusted to connect the two sides of a regenerative heat exchanger 9 alternatively to the supply of compressed methane/air mixture and to the inlet of a turbine 3. A combustion chamber 8 is provided between the two sides of the regenerator and, in normal operation, the compressed methane/air mixture passes through one side of the regenerator, is burnt in the combustion chamber and then passes through the other side of the regenerator to the turbine, whence it passes to exhaust by way of the hot side of the heat-exchanger 2. Initially, the methane/air mixture will not reach the combustion chamber in the required condition of pre-heat and provision is made (as at 5a) for the supply of auxiliary fuel (e.g., town gas or coal fines) to the combustion chamber to enable the necessary temperature conditions to be attained. In normal operation, the combustion gases, in passing from the combustion chamber to the turbine, heat up the matrix of one side of the regenerator and, in so doing, are themselves cooled to a temperature acceptable to the turbine; the incoming methane/air mixture is pre-heated during passage through the other, previously-heated side of the regenerator. The change-over valve is periodically operated to ensure that the matrix through which the incoming methane/air mixture passes is capable of imparting the necessary degree of pre-heat.

Patent No. 641,154 is concerned with an early Power Jets proposal to employ a gas turbine in the blowing of a blast furnace. In the arrangement shown in Fig. 9, page 805, a compressor 1, 2 is driven by turbines 3 and 4 and a combustion chamber 8 is provided between the compressor and the high-pressure turbine; the combustion chamber receives, as fuel, blast-furnace gas from a gas-compressor 11, 12. Air bled from an intermediate stage of the compressor 1, 2 passes through a tubular heat exchanger 5, the hot side of which receives the exhaust of the low-pressure turbine, and then passes through a second heat exchanger 6 to the blast. The hot side of the second heat exchanger receives the products of combustion from a re-heat chamber 9, which, in turn, receives the exhaust from the high-pressure turbine. It is a feature of the invention that the stage of the compressor 1, 2 from which the blast air is bled is such that the pressure of the air passing through the cold side of the heat exchanger 6 is approximately equal to that of the gases passing through the hot side; this facilitates the construction of that heat exchanger, particularly if it is to be of the rotary regenerative type.

At the present time, the question of economical blast-furnace blowing with the aid of gas-turbine technology is receiving considerable attention in the Power Jets consultancy department. None of the relevant recent patent applications have as yet reached the publication stage, but it is possible to give brief particulars of the cycle currently in favour; this is illustrated by Fig. 10, page 805. In this scheme, an air compressor 1, a gas compressor 9, an air expander 4 and a gas turbine 11 are mounted on a common shaft. The flow from the air compressor all goes through the cold side of a heat exchanger 2 and is then divided into two streams, of which one is expanded to blast pressure in the air expander and then heated in an air heater 7, before passing to the blast by the line 8; the other stream goes to the air heater by way of a combustion chamber 6 and, after giving up heat in the air heater, is re-heated in a second combustion chamber 10 before final expansion in the turbine 11, whence it goes to exhaust via the hot side of the heat exchanger.

The next patent for review is No. 641,062, and this is also concerned with metallurgy. In many metallurgical processes, such as the smelting of iron or steel in a blast furnace, wastage is liable to occur due to oxidation of the molten metal immediately after tapping; in such processes, moreover, advantage may often be obtained by oxygen enrichment of the atmosphere in the blast furnace or other apparatus. According to the invention, air is liquefied to provide oxygen for enrichment of the atmosphere within a furnace and nitrogen derived from the liquefaction is employed to blanket and thus protect molten metal as it is withdrawn from the furnace. It is suggested that the whole of the blast for the furnace may be produced by a gas turbine burning blast-furnace gas as fuel and also providing compressed air for the liquefaction process.

The last two patents to be reviewed are Nos. 684,028 and 684,241, and they relate to the manufacture of combustible gas from wet fuel, such as coal or peat, by means of a blast of hot air or gas; the two patents may be illustrated by Fig. 11, which is reproduced from the specification of the latter patent. Gasification from wet fuel has the advantage that the fuel may be ground or pulverised in that condition and pumped directly into the gasification chamber; on the other hand, the blast has to be pre-heated to a high temperature (say 900 deg. C. in the case of wet coal) to ensure gasification. In the process illustrated by the drawing, fuel is supplied by way of a fuel valve alternately to two gas producers 1 and 2; assuming the producer 1 to be in operation and in receipt of fuel, the two-way valve 9 is set to allow air from the compressor 10 to pass into a regenerator 6 and thence via dust collectors 7 and 8 to the idle producer 2, whence the blast passes by a duct 4 to the operative producer 1. The hot gases produced in the producer 1 pass through further dust collectors, also indicated by the references 8 and 7, into a further regenerator 5, which absorbs some heat from them; the gases leaving the regenerator are led, by the valve 9, to the turbine 11, by which the compressor is driven. Alternate operation of the two producers, with reversal of the valve 9, keeps the regenerators at the pre-heating temperature required to ensure gasification.

Conclusion.—In the above and foregoing sections, specific mention has been made of some 112 British patents; these have been selected from over 300 granted patents, while Power Jets have pending at the present time about 150 British patent applications. If all foreign countries are included, the total number of applications and patents in which Power Jets are interested exceeds 2,300. This is indeed a formidable portfolio; and yet "formidable" is hardly the appropriate adjective, for this huge national asset is not used in any restrictive manner. The Power Jets licensing policy, in addition to being non-discriminatory, is based on a "catalogue" of royalty rates so reasonable that to search for an alternative solution to a problem, purely for the sake of avoiding one of Power Jets' patents, would rarely be economic; professional pride should not arise as a reason for wishing to refrain from taking advantage of a Power Jets' invention since, in addition to being itself outside the manufacturing field, Power Jets draws upon the brain power of a very great number of variously situated technicians (including a large body of Government research workers), who are also not associated with any manufacturing concern. It seems reasonable to predict, therefore, that the near future should see licensed use of Power Jets' inventions in the industrial field at least to the same extent as in the aero field.

THE INSTITUTION OF NAVAL ARCHITECTS.

(*Concluded from page* 778.)

THE ninth and last paper presented at the Spring Meeting of the Institution of Naval Architects, held in London from March 25 to 27, was delivered at the afternoon session on March 27 by Professor G. Aertssen and dealt with "Sea Trials on a 'Victory' Ship, AP3, in Normal Merchant Service." Like the preceding paper, the discussion on which was reported on page 776, *ante*, it was read before a joint meeting of the Institution with the Institute of Marine Engineers. The chair was occupied by Mr. Lloyd Woollard, M.A., a vice-president of the Institution, who was accompanied on the platform by Mr. R. Cook, a member of the Council of the Institute of Marine Engineers. A summary of the paper is given below.

SEA TRIALS OF A "VICTORY" SHIP.

The investigations covered by the paper, Professor Aertssen explained, formed part of a programme undertaken in 1948 by the Centre Belge de Recherches Navales on the propulsive machinery of two cargo vessels of about 10,000 tons deadweight, one having a steam turbine and the other a Diesel engine. The paper dealt with the turbine-engined ship, the s.s. Tervaete, belonging to the Compagnie Maritime Belge. The purpose of the research was to bridge the gap between model-tank results and service performance by determining, as accurately as possible, the efficiency and economy of the ship and her machinery under different conditions of weather and fouling. Careful records were kept of the fuel consumption, steam consumption and power output (measured by a Siemens-Ford torsionmeter and a specially-designed thrustmeter made by the Kingsbury Machine Works); and, during one voyage, a progressive measured-mile trial was made, which enabled a comparison to be made with the results of model tests conducted by Dr. J. F. Allan at the National Physical Laboratory. The speed was measured with a Pitometer log. The paper was divided into five main sections, of which the first described the scope of the investigation and the measuring apparatus provided. The second part dealt with the sea trials, which extended over a succession of ordinary trading voyages; the third part discussed the accuracy of the measurements made; the fourth consisted of an analysis of the machinery performance; and the fifth dealt similarly with the data and the observations bearing on the propulsive efficiency. In three appendices, the author reviewed the correlation experiments relating the performance of the ship and the model, the pitching diagrams obtained in service, and some investigations into the boundary-layer velocities along the hull.

DISCUSSION.

Dr. J. F. Allan, who opened the discussion, said that he wished to thank Professor Aertssen, the Belgian Naval Research Association and the Compagnie Maritime Belge for having submitted such a valuable paper. It contained a mass of valuable information on both the hull performance and the machinery performance, and showed the great difficulty of obtaining ideal data from a ship during its normal service. The thrustmeter, as Professor Aertssen had pointed out, was not ideal, because it measured only the thrust on one thrust-pad out of six. Although the makers claimed a high degree of accuracy, he had limited that to some 6 per cent. Dr. Allan thought that he was right in doing so. The author referred to temperature correction on the ship in tropical waters by the method proposed by the International Conference in Paris in 1935, but Dr. Allan considered that correction to be one which should not be applied to the ship, as it was in error; as was agreed in 1935, it was reasonably correct for the average model range used at that time, but it was never intended to be applied to the ship condition, especially over so wide a range of temperatures. Appendix I contained the report from the N.P.L. on the experiments made there in collaboration with the Belgian Research Association. The experiments were carried out in the normal way. The appendix gave the tank prediction for the clean ship, in the new condition. It was based on what was termed the 0·9 correlation factor, which, in its turn, had arisen from a large amount of ship-model preparatory work with which the N.P.L. had been concerned, along with the British Shipbuilding Research Association. It had not been published, but it showed that the flush-welded ship performed considerably better than the riveted ship.

In that appendix, the results of the model experiments and the full-scale results were compared in two graphs. The full-scale data include both measured-mile trial results and observations on voyages in calm weather. The paper stated that, "After making any reasonable allowance for weather conditions, there remain considerable differences. If we accept . . . that the results obtained in December, 1951, represent a fairly clean ship, the 20 per cent. margin shown may be considered to represent the difference between the actual hull finish at that time and the assumed datum condition. The trial results obtained four months later show a margin of about 45 per cent., and it is reasonable to suppose that this difference is mainly due to fouling during that period. . . ." Those differences were very disturbing and served to show that the ship, when comparatively clean, was not performing anything like so well as a completely new well-painted butt-welded form. The Admiralty coefficient at 16 knots, predicted by the tank results, was about 490, and at 15 knots it was about 515; those were figures which had been obtained during the past two or three years in somewhat similar ships. The Admiralty coefficient obtained for the vessel in service was of the order of 425, which was still quite a reasonable figure. Dr. Allan also drew attention to the propulsive coefficients shown in the table giving the estimated performance of the ship, based on tests with a model. In the region of 15 to 16 knots, in the deep condition, the propulsive coefficient was 0·76 and 0·77, and in the lighter condition it was 0·81. The plotted results of the sea trials showed the deduced values for effective horse-power in relation to developed horse-power, which were of the general order of 80 per cent. or slightly above. They were in reasonable agreement with the model figures, but seemed to be on the high side. However, the accuracy of the whole process was not such as to enable a fine distinction to be made as to scale effect in the results, because of the influence of thrust deductions and scale effects in the propeller. It was interesting that there was a reasonable comparison between the propulsive coefficients. The paper contained some interesting diagrams in which the author had attempted to plot the effects produced by weather conditions in a variety of ways, and these seemed to fall into a reasonable pattern.

Dr. W. P. A. van Lammeren said that he had read the paper with particular interest, not only because he had the pleasure to attend the measured-mile trials at Polperro, but also because, at the Wageningen model basin, in Holland, similar tests were being made on a number of "Victory" ships as part of an extensive research programme on the correlation between tank predictions, based on ship-model experiments, and trial and service performance. That research did not cover the determination of the efficiency and economy of the machinery. Besides some preliminary tests on one of the goesims at full draught, and numerous tests on the 72-ft. model of the D. C. Endert, Jr., a series of tests had been carried out on the 17-knot "Victory" ship Arnedijk, of the Holland America Line, during a trip between Rotterdam and New York after an extensive overhaul of the ship in dry dock in September, 1952. A series of measurements was made, covering a speed range from 8 to 18 knots in various weather conditions. The allowance on developed horse-power predicted by the tank for the self-propulsion point of the ship varied from 54 per cent. at relative wind speeds of 12 to 16 m. per second, with the wind slight, abaft the beam, and a wave height of 0·65 m., to 14 per cent. at a relative wind speed of 8 to 11 m. per second, with the wind about 40 deg. off the bow, and a wave height of 0·25 m. The tank-test results of the 19-ft. model (scale 1/23), corrected for the draughts given in the paper, were in good agreement with those given by Dr. Allan, if the correlation factor of 0·9 was applied. That did not mean that he agreed with the application of that factor; it was used only for comparison. It was not clear to him what correlation in thrust corresponded with the correlation factor for developed horse-power; therefore he did not attempt to compare the curves for thrust. The revolutions were corrected in such a way that the relation between developed horse-power and revolutions was kept constant, i.e., the r.p.m. were kept the same for the same developed horse-power. Accurate speed measurement on the open sea was most difficult; for the sake of security, therefore, they had applied two different speed-log devices on the Arnedijk. The application of two logs also had the advantage that the results of velocity measurements in the boundary layer, carried out with one log, could be corrected for eventual variations in the ship speed, measured with the other log. He thanked the author for a very instructive paper, and for his co-operation in providing a valuable extension of the "Victory" ship performance data which were being collected as part of the model-ship correlation programme at Wageningen.

Mr. G. Dufour, who represented the owners of the ship, expressed their satisfaction at the conclusion of a series of experiments of great scientific interest. It was difficult for shipowners to appreciate fully all the information that had been gained, but they had drawn a practical commercial lesson. They knew that, in the course of years, no matter how clean a ship might be after dry docking, she was never as smooth as when new, and Professor Aertssen's work had given them more information on that matter. They had learned, also, that more care should be taken in the proper painting of the hull.

Professor E. V. Telfer said that the paper was an excellent one, which stimulated a desire for still more information. Could the author provide also a propeller plan, a line plan, and a rudder plan? Without those, the information given in the paper was not complete. He proposed to offer, in a written contribution, a power diagram of the generalised type that he had given about 27 years earlier in a paper which contained certain predictions made as the result of extensive experience; it anticipated a number of the contributions which the author made to the subject in his own paper. In 1934, after a period of real slump in the shipping industry and when ships were running at much lower designed powers than formerly, he was disturbed to find that the relation he had got at fairly full power no longer applied. Gradually he realised that absolute power itself was also important, and he was able to linearise the loss, making use of an artificial function (weather per 1,000 h.p.); by modifying the description of weather to a basis of 1,000 h.p. the results came on one line. At the Belgian Conference in June, he hoped to show just what that meant in simple terms, and also what Professor Aertssen's diagrams meant. Ships at sea experienced a power loss of a constant amount, independent of the power which the ship itself was using. That power-loss factor would be a feature of each particular ship, independent of how much power was being used; power-loss factors could then be investigated in terms of wave height and other disturbing forces in a manner which it had not been possible to adopt previously. Another point was the very heavy loss due to fouling. He had made a rough check in the light of his 1951 paper to the Institution, in which he had shown the changing roughness and changing density of roughness; the amount found was of the order found between the model and the trial data, which suggested that most of the difference between the model and the trial data was due to shell-fouling roughness of the ship and not necessarily to the deterioration of the ship's structure.

Professor Aertssen commented briefly on some of the points raised in the discussion, adding that he would reply more fully in writing.

BRITISH INSTRUMENT INDUSTRIES EXHIBITION.

THE second biennial British Instrument Industries Exhibition will be opened at mid-day on Tuesday, June 30, at Olympia, by the Minister of Supply, Mr. Duncan Sandys, and will remain open until Saturday, July 11, between the hours of 10 a.m. and 6.30 p.m. The exhibition is organised by F. W. Bridges and Sons, Limited, Grand Buildings, Trafalgar-square, London, W.C.2, with the active support of the trade associations representing the electrical, process-control, scientific glassware, drawing-office equipment, and scientific instrument industries. This year, nearly 200 firms are taking part. During the two years that have passed since the first exhibition in 1951, the industry has maintained the value of its exports at about 14*l.* million per annum, and it can now be said that most types of instruments in demand by British industries can be supplied from within the United Kingdom. We give below descriptions of some representative exhibits having industrial applications.

INTERFERENCE MICROSCOPES.

C. Baker of Holborn, Limited, 244, High Holborn, London, W.C.1, will be demonstrating their full range of microscopes and accessories, among which may be mentioned an oil-immersion fluorite microscope objective with a magnification of × 50 and a numerical aperture of 0·95, which is said to have remarkably fine corrections and an appreciably flatter field of view than is usual with this type of lens. A new interference microscope arranged for transmitted light, a photograph of which is reproduced in Fig. 1, opposite, is claimed to be the first practical instrument of its kind. Of greater interest to the high-precision engineering industries is the portable surface-finish testing form of the interference microscope in which a bi-refringent element in the microscope produces interference fringes in the eyepiece, which are bent by lack of flatness in the object under examination. The effect on the fringes can be measured by a micrometer eyepiece, giving a measure of the surface finish of the object.

PHOTO-ELECTRIC CONTROL EQUIPMENT.

Elcontrol, Limited, 10, Wyndham-place, London, W.1, will be showing examples of photo-electric control equipment and switches, cyclic timers and delay switches, electronic release, and infra-red sensitive equipment for safeguarding furnaces. Fig. 2, on page 816, illustrates safeguard equipment developed for use with gas burners, for which it is particularly suited. It employs a lead-sulphide cell in conjunction with an amplifier and a relay control unit. The controlling relay, which is connected in circuit with fuel valves or burner motors and alarm signals, is energised only when a flame is present. The equipment is suitable for both luminous and non-luminous flames of all types, and it discriminates between flames and glowing refractory or other

bodies without recourse to sensitivity control. The viewing head is small and compact and is suitable for mounting in a standard 2-in. pipe welded on to the burner front plate.

The photo-electric registration control to be shown on the Elcontrol stand has been designed to detect and rectify an out-of-register condition in printing and packaging processes. In the example on the stand, wrapping paper is accurately cut by a rotary knife, the feed control of the material being arranged to underfeed slightly. An electrically-operated ratchet is arranged to advance the material very slightly when it receives an impulse from the registration controller. The latter comprises a photo-electric scanner unit consisting of a light source and an optical system together with a photo-electric cell, a voltage amplifier, and cathode follower; and a control unit containing an amplifier with variable gear control, a thyratron and valve rectifier circuit, for operation from a 200 to 250-volt 50-cycle supply.

The method of operation is as follows: A light spot of high intensity is projected obliquely on to the edge of the web directly in the path of the registration marks. Light reflected from the web illuminates the cathode photocell. Should the web be out of register, so that the reflected light is interrupted by a registration mark, a signal will be transmitted to the control unit where the thyratron energises the correcting mechanism to advance the position of the web in relation to the rotary knife. A blocking contact actuated by a cam driven coaxially with the rotary knife holds the control inoperative when the web is in correct register. This contact also serves to reset the control for successive operations. The machine is started with a registration mark in advance of the light spot by a distance equal to twice the maximum permissible deviation from the correct register; the blocking contact is just opening in this position. As the web passes through the machine, the incremental error decreases until the web is in correct register, then increases in the opposite direction. At the maximum deviation, a register mark interrupting the light beam causes the correcting mechanism to advance the web by twice the maximum permissible error, and the cycle is repeated. The rate of underfeed is arranged to pass the greatest possible number of wrappers through the machine between corrections.

Pneumatic Transmitter.

The products of Elliott Brothers, Limited, Century Works, Lewisham, London, S.E.13, range over a wide field, and in co-operation with their associate, the Fisher Governor Company, Limited, they claim to offer a complete instrument service to industry. Their exhibits will include a variety of electrical measuring instruments, electrical equipment for remote indication and control, magnetic amplifiers, strain-measuring equipment, examples of miniature circuit techniques, microwave instruments and apparatus for process control. Among the latter is their new Drimac pneumatic transmitter, which converts a static pressure derived from a process variable such as rate-of-flow, pressure, level, or density, into a proportional pneumatic output. It is operated on the force-balance principle which renders its accuracy virtually independent of the supply pressure and the pneumatic output. The transmitter is available for operation from input pressures of from 0·5 in. to 700 in. w.g., and the pneumatic output (which can be applied to remote indicating recording, or control) ranges from 3 lb. to 15 lb. per square inch.

Strain-Measuring Equipment.

Among the examples of strain-measuring equipment to be shown on the stand of Elliott Brothers is the load cell illustrated in Fig. 3, page 816. It comprises a high-tensile steel load-carrying member, with bonded resistance wire strain gauges connected as a bridge circuit, and housed in a hermetically-sealed cylindrical casing provided with a cable-entry gland. The force to be measured is applied to the load-carrying member, stretching or compressing it and thereby causing a change in the resistance of the strain gauges which produces an output signal from the bridge circuit proportional to the applied force. The bridge is excited from a low-voltage source, and provides an output signal of 2 mV per volt input to the bridge for full load. The cell is self-compensating for temperature variations, and has a calibration accuracy within $\pm 0{\cdot}25$ per cent. of the full range at all points from 0 to 100 per cent. of the capacity. The cells are available for compressive loads of $\frac{1}{2}$ ton, $2\frac{1}{2}$ tons, 15 tons, 50 tons and 100 tons. Also to be shown is a self-balancing servo-operated bridge strain indicator for indicating load-cell outputs, suitable for use by unskilled personnel. It can be supplied with a centre zero, with a range of $\pm 0{\cdot}1$ per cent. strain, or with a side zero with a range from 0 to 0·2 per cent. strain. The indicator may be used with gauge factors of 1·7 to 2·4. The speed of response is 0·1 per cent. strain in 4 seconds. Controls are provided for apex balance, quadrature balance and gauge factor.

BRITISH INSTRUMENT INDUSTRIES EXHIBITION.

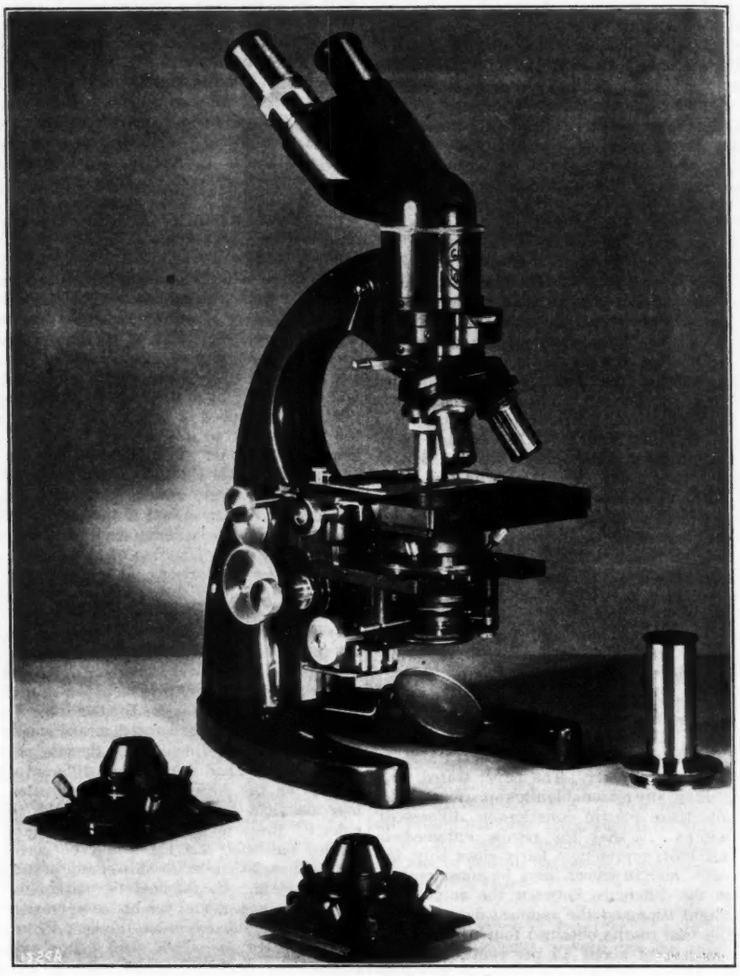


Fig. 1. Interference Microscope; C. Baker of Holborn, Ltd.

Electronic Digital Computer.

The exhibits of Ferranti, Limited, Hollinwood, Manchester, will include an electric gyroscopic horizon for aircraft, viscometers, vacuum test equipment, electrical meters and test sets, and a scale model of the Manchester electronic digital computer which they are constructing for commercial use under licence from the National Research Development Corporation. The Manchester computer consists of two bays, each 16 ft. long, 8 ft. high and 4 ft. wide, and a separate control desk. A full-size control desk, and a section of the computer rack showing the wiring of the valves and components, will also be on view. Part of the full-scale computer bay is illustrated in Fig. 4, on page 816; the components are mounted on chassis fixed to hinged doors which swing outwards to give easy access for servicing. The Manchester computer, which can perform all arithmetical operations at high speed and can decide upon alternative courses of action prescribed by the instructions fed into the machine, embodies a magnetic drum store capable of storingpermanently 650,000 binary digits (equivalent to ab out 15,000 twelve-digit decimal numbers). In addition, it has a high-speed storage capacity, on cathode-ray tubes, for 10,000 binary digits (equivalent to about 3,000 decimal digits). Information is fed into the computer on punched teleprinter tape at a rate of up to 200 characters per second. The results can also be taken out on punched tape or they can be printed directly by teleprinter. A high-speed photo-electric tape reader, originally designed for use with the computer, but with many other applications in the field of communications, will also be shown. It is designed to read standard five-hole or seven-hole teleprinter tape, run continuously, at a rate of 200 characters per second.

Miniature Ultrasonic Flaw Detector.

Kelvin and Hughes, Limited, New North-road, Barkingside, Essex, will be showing examples of their process-control equipment, a four-channel dynamic strain recorder developed for the Royal Aircraft Establishment, and ultrasonic flaw detectors, among which may be mentioned the Mark 5 miniature flaw detector, illustrated in Fig. 6, on page 816, which has been developed for inspecting

TWIN-SCREW PASSENGER LINER "ANDREA DORIA."

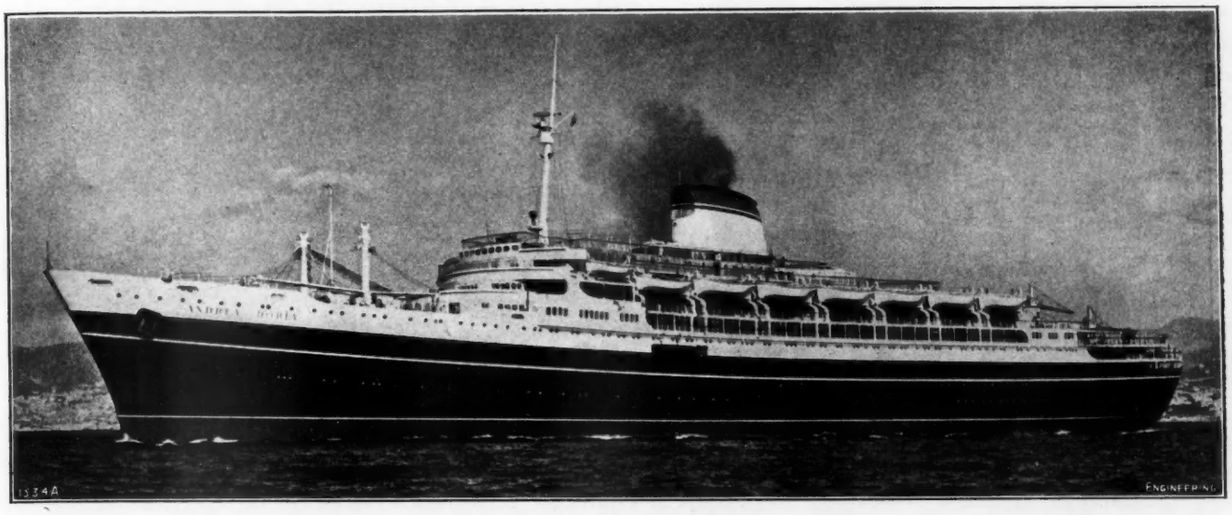


FIG. 1. VESSEL LEAVING HARBOUR.

welded pressure vessels where the instrument must be passed through a manhole. A description of this instrument appeared on page 363, *ante*.

MINIATURE LINK TESTING AMMETER.

The General Electric Company, Limited, Magnet House, Kingsway, London, W.C.2, are introducing a miniature link testing ammeter, illustrated in Fig. 5, on page 816, for measuring alternating currents up to 50 amperes. The instrument, which enables the current in a circuit to be measured without breaking the connections, comprises in effect a split-core current transformer connected to a sensitive moving-coil rectifier instrument calibrated in amperes. The current transformer consists of a pair of links, one of which is fixed and the other is hinged to enable the links to encircle the conductor under test. A thumb-operated switch enables the appropriate current range—1 to 10 amperes, 2·5 to 25 amperes, or 5 to 50 amperes—to be selected. The complete instrument is housed in a Bakelite case, and the links are fully insulated for use on bare conductors up to 600 volts.

Also on view, in addition to standard electrical instruments, frequency meters, and synchroscopes, will be a new self-contained alternating-current circuit analyser for measuring voltage, current, power and power factor simultaneously; and a new link testing power-factor meter. Demonstrations will be given of a magnetic sorting bridge for indicating physical and chemical differences in ferrous components and arc stock; and, shown by the subsidiary company, Salford Electrical Instruments, Limited, Peel Works, Silk-street, Salford, 3, will be an electro-mechanical transducer for measuring mechanical quantities electrically and indicating the results at a distance.

ULTRASONIC THICKNESS GAUGE.

Dawe Instruments, Limited, 83, Piccadilly, London, W.1, will be showing instruments for acoustical and vibration measurements, stroboscopes, dynamic balancing equipment, a direct-reading moisture meter for determining the moisture content of wood, and a multiple-point inflammable gas monitor, still under development, designed to provide a warning of the presence of petrol vapour in restricted areas of oil tankers when they are loading or discharging oil. Fig. 7, page 816, shows the firm's ultrasonic thickness gauge, which has recently gone into production. It has been developed for applications where only one surface of the material is accessible, and can cover a thickness range from $\frac{1}{4}$ in. to 12 in. of steel, with an accuracy of $\pm$ 3 per cent., provided that the working surface is clean and flat. It can also be used for measuring the thickness of brass, aluminium, copper, nickel, glass and some plastic materials. It operates from self-contained dry batteries and, measuring only 12 in. by 8 in. by 14 in. and weighing only 24 lb., it is easily portable. The Dawe ultrasonic thickness gauge, which operates on the resonance principle, determines the natural frequency of vibration in the thickness direction of the material under test. A vibrating quartz crystal, driven by an electronic oscillator, is placed in contact with one surface of the material, to which a thin film of oil, grease or glycerine has first been applied to provide a good coupling. It transmits an ultrasonic wave, which travels through the material in a narrow beam, and is reflected by the opposite surface. At certain frequencies, the transmitted and reflected waves are in phase and give rise to a relatively large increase in the amplitude of the vibration. This occurs when the frequency is inversely proportional to twice the thickness and directly proportional to the velocity of sound in the material. Resonance also occurs at harmonics of the fundamental frequency. By frequency-modulating the electronic oscillator, a signal is produced at the fundamental frequency and its harmonics. The difference in frequency between any two adjacent harmonics, numerically equal to the fundamental frequency, is measured on a frequency scale. The signal strength is heard in a set of headphones and is also indicated on a panel milliameter; as the frequency is varied, a sharp increase in the signal strength indicates the resonant condition. A conversion scale on the instrument panel indicates the thickness corresponding to the measured frequency difference. For use on curved surfaces, special crystal units can be supplied.

CONTROL OF INTERLINKED FILM PROJECTORS.—Unless a wide screen is used, the showing of three-dimensional films makes it necessary for the two projectors to be interlocked, so that both run in synchronism, instead of alternately as with non-stereoscopic film. As the projectors subtend an angle of about 6 deg., the use of a rigid connecting shaft is out of the question, while a flexible shaft introduces lost motion, which is difficult to control. The General Electric Co., Ltd., Kingsway, London, W.C.2, have therefore designed an electrical system whereby the speed of the $\frac{1}{4}$-h.p. split-phase induction motors driving the projectors is maintained accurately at 1,440 r.p.m. To do this a Twin Torq motor (a new two-pole machine and a single-phase wound rotor) is coupled to each driving motor, while the four motors are electrically connected so that if a driving motor loses speed its associated Twin Torq motor follows suit. An angular displacement between the two Twin Torq rotors is thus created, so that current flows from one stator to the other. Equal and opposite torques are then produced on the Twin Torq rotors, which are thus pulled into step.

POST-WAR ITALIAN LINERS: II.—"ANDREA DORIA."*

THE twin-screw turbine liner Andrea Doria, built at Genoa by the firm of Ansaldo for the Società di Navigazione Italia, went into service at the close of 1952, and, with the sister ship Cristoforo Colombo, launched from the same yard on May 10 this year, places the Italian mercantile marine once again among the operators of first-class high-speed liners on the North Atlantic. Though these vessels do not compare in either size or speed with the Queen Mary, Queen Elizabeth or United States, which are in a class apart, they are notable ships, combining a high standard of comfort with a performance superior to that of what used to be regarded as the "intermediate" type of Atlantic liner—a distinction which, to a considerable extent, has lost its pre-war meaning with the great expansion of air transport between Europe and the Americas. Illustrations of the Andrea Doria and her passenger accommodation appear in Fig. 1, on this page, Figs. 3 to 6, on Plate XXVI, and Figs. 7 and 8, on page 811; and a photograph of one of the two sets of main turbines, taken during erection in the Ansaldo works, is reproduced in Fig. 2, on page 810.

The Andrea Doria has a gross tonnage of about 30,000 on the following main dimensions: length overall, 212m. (696 ft.) and between perpendiculars, 191m. (626 ft.); maximum breadth, 27·4m. (90 ft.); depth moulded to main deck, 15·2m. (50 ft.); and draught, loaded, 9·15m. (30 ft.). She has been built under the survey, and to the highest classification, of Lloyd's Register of Shipping, the Registro Navale Italiano and the American Bureau of Shipping, and is designed to carry 1,250 passengers, in three classes, and a complement of 580, making a total of 1,830 persons. Electric welding has been used extensively in the construction of the vessel, which, as can be seen from Fig. 1, has a raked stem and cruiser stern, and presents a particularly well-balanced outline. The hull is divided into 11 watertight compartments by transverse bulkheads, all of which are continued up to the main deck, and the collision bulkhead to the upper deck. The arrangement of the bulkheads is in accordance with the regulations adopted by the 1948 International Convention for the Safety of Life at Sea and is such that the vessel can remain afloat

* Part I, dealing with Giulio Cesare, appeared on page 261, *ante*.

TWIN-SCREW PASSENGER LINER "ANDREA DORIA."

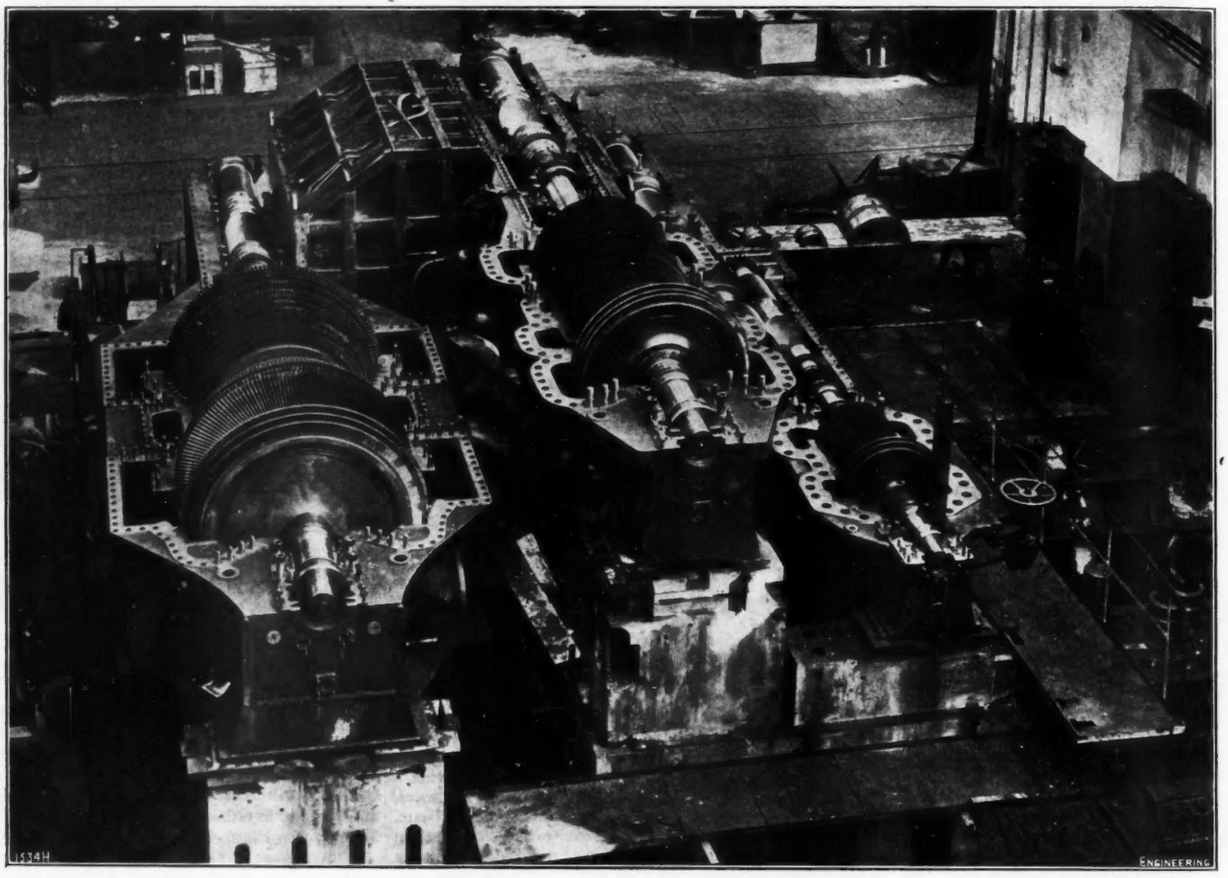


FIG. 2. TURBINES AND GEARING IN BUILDERS' WORKS.

with any two adjacent compartments flooded. The cellular double bottom extends for the full length of the ship, and, in way of the machinery spaces, is continued as wing tanks to above the water line.

PASSENGER ACCOMMODATION.

The passenger accommodation is disposed on ten decks, of which four—the promenade deck, upper deck, main or foyer deck, and A deck—are continuous. The space on B and C decks is only partly devoted to passengers, being interrupted by machinery spaces, etc.; and the sports deck, sun deck, "Lido deck" and boat deck form the superstructure—which, it may be remarked here, is largely constructed of light alloys. At the after end of the superstructure, the Lido deck, boat deck and promenade deck are stepped down in succession, so that, abaft of each, there is an open space on the deck below. This enables an open-air swimming bath to be provided for each of the three classes—first class on the Lido deck, cabin class on the boat deck, and tourist class on the promenade deck. Fig. 3, on Plate XXIV, shows the swimming bath for the first-class passengers.

The principal first-class rooms are on the promenade deck and comprise, at the forward end, a ball room, aft of which are the lounge and a cocktail lounge. An enclosed "winter garden" surrounds the ball room on three sides, and abreast of the two lounges there are enclosed promenades. On the boat deck, at the forward end, there is an observation lounge with an open balcony, overlooking the fore deck, and abaft of the observation lounge and communicating with it, the reading room, writing room and card room. The balcony extends aft on both sides of the boat deck as open promenade spaces. On the Lido deck, which is solely for the use of first-class passengers, are a gymnasium, a children's play-room, and, at the after end, an open veranda and the swimming pool. The open space at the after end of the sun deck forms a terrace overlooking the first-class swimming pool on the Lido deck. The first-class foyer and dining saloon are on the main deck, where also is the ship's chapel. The staterooms have either one or two beds and each has a private bathroom. There are also four *suites de luxe*, each with a bathroom, day cabin, boudoir and a private baggage room.

For the cabin-class passengers there are open promenades on the boat deck, with a veranda adjoining the cabin-class swimming pool; enclosed promenades on the promenade deck, where also are the lounge, ballroom, and reading, writing and card rooms; and a large dining saloon on the main deck, abaft the engine casing. The tourist-class dining saloon also is on the main deck, separated from the cabin-class saloon by the cabin-class foyer; thus all three dining saloons are on the same deck, an arrangement which considerably simplifies service. All three extend to the full breadth of the ship, and are reached by lifts from the upper decks. Hot and cold water is provided in all cabins, and the whole of the passenger accommodation is air-conditioned. Among the other amenities provided there are five cinemas—one being in the open air—and laundries, hairdressing rooms, a photographic dark-room, fully-equipped hospitals, banking facilities, and provision for broadcasting music and radio programmes in the public rooms and promenades.

PROPELLING MACHINERY.

The decision to adopt steam turbines for propulsion was dictated by the desire to provide an ample margin of power while retaining a low fuel consumption, and the fact that, for the particular service requirements, turbines offered the simplest machinery arrangement in conjunction with this flexibility. Each set of main engines develops 25,000 shaft horse-power and comprises high-pressure, intermediate-pressure and low-pressure turbines driving on to a common gearwheel, the gearing being double-reduction in the case of the high-pressure turbine, with gear ratios of 1 : 2·14 and 1:11·456, and single-reduction for the other two turbines. The designed revolutions of the propellers were 140 per minute at the service speed of 23 knots, and 160 at the maximum contract speed. On the full-power trials, the maximum was 173 r.p.m., corresponding to a shaft horse-power of 60,200 and a speed of 26·4 knots.

The high-pressure turbine has two impulse stages and 19 reaction stages, and is supplied with steam through 46 nozzles, in groups of 9, 15, 13 and 9, thus providing a wide choice of admission conditions. The ahead intermediate-pressure turbine has 24 reaction stages. After the 17th stage there is a connection to supply bled steam, at 35·5 lb. per square inch, to the high-pressure feed-water heaters. The low-pressure turbine is of the double-flow type, with 16 reaction stages. For astern running, there

TWIN-SCREW PASSENGER LINER "ANDREA DORIA."

(*For Description, see Page* 809.)

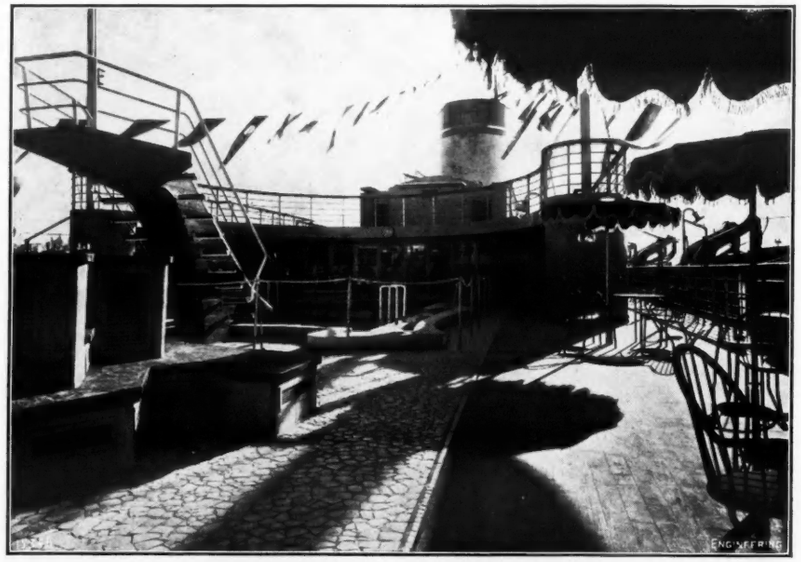


FIG. 3. FIRST-CLASS SWIMMING BATH.

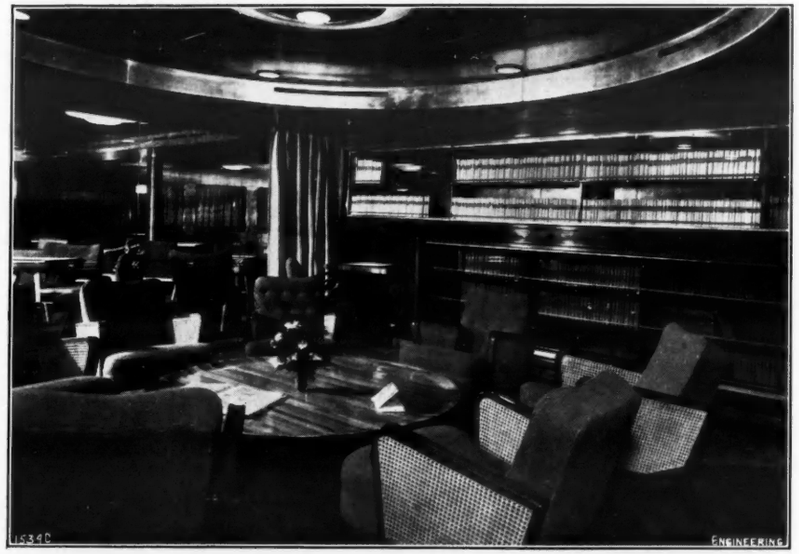


FIG. 4. FIRST-CLASS READING ROOM.

FIG. 5. FIRST-CLASS OBSERVATION LOUNGE.

FIG. 6. FIRST-CLASS DINING SALOON.

(*To face page* 810.)

TWIN-SCREW PASSENGER LINER "ANDREA DORIA."

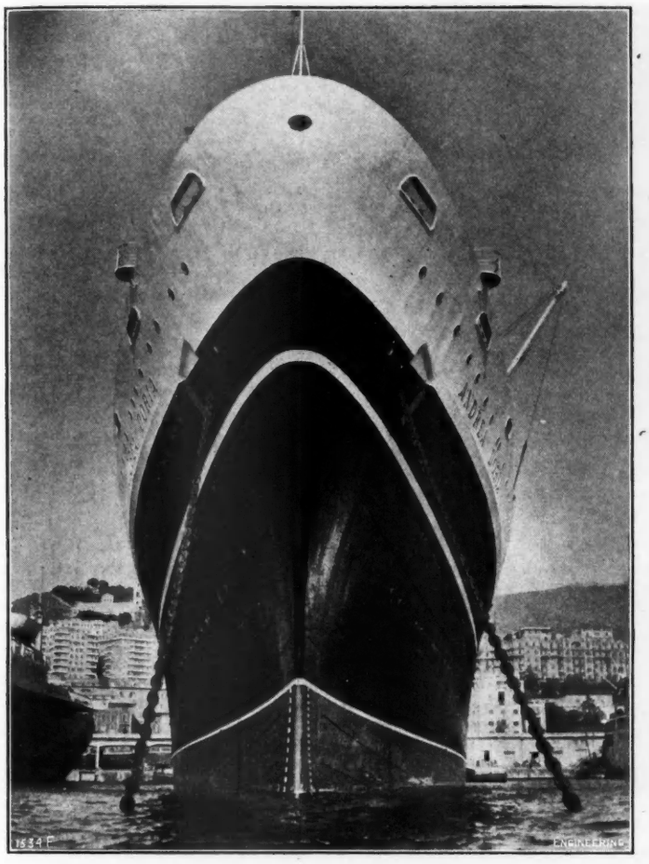


FIG. 7. BOW OF VESSEL.

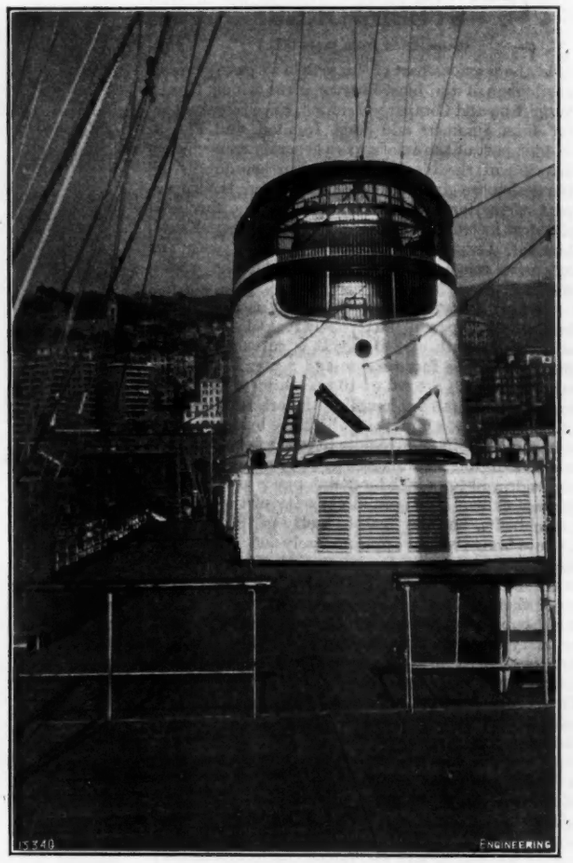


FIG. 8. FUNNEL, SHOWING SMOKE DEFLECTOR.

is a three-stage impulse turbine in the intermediate-pressure casing and another, also with three impulse stages, in the low-pressure casing. Emergency cross-connections enable any turbine to be cut out in the event of damage, while the other two continue to function. The condenser, of the Weir regenerative type, is arranged beneath the turbines in the usual way.

Steam is supplied by four water-tube boilers of the Foster-Wheeler type, built under licence in the Ansaldo works and operating at a pressure of 46 kg. per square centimetre (655 lb. per square inch) and a steam temperature of 450 deg. C. (842 deg. F.). The normal service power of 35,000 s.h.p. can be obtained with only three boilers in use, and it is stated that they can be safely forced to give the maximum contract output of 50,000 s.h.p., though, for this power, four boilers would normally be used. The design of this type of boiler, with two combustion chambers separated by a vertical bank of tubes, enables a precise control of the superheat to be maintained, irrespective of load, by varying the number of the Todd oil burners in use. The boilers are arranged in pairs athwartship, with the firing aisle for and aft between each pair; and the two auxiliary boilers, of Babcock and Wilcox design, are situated in the wings, between the two pairs of main boilers. The auxiliary boilers work at a pressure of 10 kg. per square centimetre (143 lb. per square inch) and supply steam for the ship's auxiliary services, and to the evaporating and distilling plant. All the boilers are fitted with soot-blowers supplied by Clyde Blowers, Limited, Clydebank, Glasgow; the soot-blowers are manually operated from the firing platform.

It was mentioned above that the main condensers are of the Weir regenerative type, developed by Messrs. G. and J. Weir, Limited, of Cathcart, Glasgow. These form part of a complete Weir closed-feed system, including, in addition to the condensers, air ejectors, drain coolers, closed-feed control valves, condensate extraction pumps, main and auxiliary boiler-feed pumps, high-pressure and low-pressure feed-heaters, and boiler-feed regulators. The four main feed-pumps (two working and two stand-by) are three-stage turbine-driven units, each with an output of 232,000 to 304,000 lb. per hour when supplied with steam at boiler pressure and a temperature of 788 deg. F.; they were made by Messrs. Weir at Cathcart. Many of the other pumps in the engine and boiler rooms are of the electrically-driven vertical-spindle centrifugal type, either supplied by their associated firm, Drysdale and Company, Limited, of Yoker, or constructed in Italy to their designs. The condensers and drain coolers were made in Italy under license. The four extraction pumps, mentioned above, have a capacity of 136,000 to 204,500 lb. per hour each.

In a separate compartment, forward of the boiler room, is the electricity-generating plant, consisting of five 750-kW sets, each driven by a seven-cylinder single-acting Ansaldo Diesel engine of 1,200 h.p., running at 250 r.p.m. Direct current is supplied at 220 volts. Two electrically-driven starting-air compressors are located in the same engine-room. There are also, in the main engine-room, two Ansaldo turbo-generator sets of 1,000 kW each, taking steam from the main boilers. The turbo-generator condensers, as well as many of the auxiliary pumps, were made by Termomeccanica Italiana, of La Spezia.

LINING A RESERVOIR WITH RUBBER.

THE water-storage installation of the Sunderland and South Shields Water Company, Limited, at Mill Hill, Easington, near Sunderland, has been giving considerable trouble during the past few years, through subsidences due to coal workings beneath causing the continued appearance of cracks. The installation consists of two reservoirs, each 300 ft. by 360 ft., with a depth of 18 ft., and further sub-divided into two sections by walls 9 ft. in height. One of the two reservoirs and one compartment of the second reservoir have had to be taken out of use, with a consequent reduction in the storage capacity from 24 million to 3 million gallons. At the time of siting the installation, which is on clay underlaid by sand pockets across a whinstone ridge, it was thought that the coal deposits on each side of the ridge were useless, having been cindered by the heat of the whinstone when it was formed; this, however, was not so, and certain unaffected coal seams which were worked caused subsidences, which, in turn, caused serious cracks to occur in the masonry and concrete of the reservoirs.

Various semi-elastic materials for sealing the cracks were tried out unsuccessfully, and it was, therefore, finally decided that the only remedy lay in the use of rubber. The Dunlop Rubber Company, Limited, gave advice and it has now been decided to line one of the two reservoirs, so virtually creating a large rubber bag capable of containing 12 million gallons of water. The rubber sheet used will be $\frac{1}{4}$ in. in thickness, and the 16,000 sq. yards required will weigh approximately 100 tons; over a ton of adhesive will be employed. The work of providing one of the reservoirs with its elastic lining is expected to be completed in time to catch the late-autumn and winter rains.

BLAST-FURNACE PLANT AT HAWARDEN BRIDGE STEELWORKS.

(*Concluded from page 652.*)

IN the previous part of this article we gave general particulars of the blast-furnace plant which Head, Wrightson and Company, Limited, have constructed for John Summers and Sons, Limited, and Fig. 3 in that part of the article was a general arrangement drawing of the blast furnace. Further details of the design are given below. Fig. 4 shows the upper part of the furnace and Fig. 5 shows the furnace-platform instrument panel, for which George Kent, Limited, Luton, were responsible, along with an extensive range of instrumentation for the whole works.

The ore storage yard is served by a 34-ton ore bridge with a span of 180 ft.; with cantilevers it has an overall length of 310 ft. It is supported by a sheer leg on the furnace side and a pier leg on the other side, with a total of 16 travelling wheels. A four-wheeled crab for handling the ore runs on top of the double box girders of which the bridge is constructed. On the side remote from the furnace there is also a 10-ton maintenance crane, and on the furnace side a 10-ton winch for maintenance of the blast-furnace skips. The normal capacity of the grab is 225 cub. ft., but the flush capacity is 180 cub. ft. The ore bridge weighs approximately 600 tons. The stoke-house trestle on the north side of the furnace is reached by a graded rail track. The trestle is more than 1,000 ft. long and has 30 bins each of 2,100 cub. ft. capacity, four bins of 2,400 cub. ft. capacity and two coke bins each of 7,400 cub. ft. The ore bins are of the parabolic type and have double-lip type gates operated by the scale car. The coke and scrap bins are of the rigid type, the coke bins being lined with gunite. The coke is discharged from the coke bins to two single-deck vibrating screens of 1½-in. mesh. Oversize material is fed into two weigh hoppers, each with a capacity of 250 cub. ft. Undersized material from the coke screens is elevated by one or other of two skip hoists working in parallel. Each hoist has a capacity of 20 cub. ft. and discharges the breeze into a bin above the running track, so that a wagon can be loaded. A double automatic skip is provided for charging the blast furnace, ore and limestone being charged into the skip cars from the scale car and coke being discharged automatically. The scale car operator controls the hoist; once he has set the skip in motion the charging sequence is automatic. The skip cars are lined with thick manganese-steel plates and each has a capacity of 250 cub. ft. The skip-hoist winch consists of a 6-ft. diameter single drum, driven through double-reduction gearing. The skip bridge is of the through-truss type connected by pins on the top and bottom, and it supports a double track for the cars.

The hoist house for the furnace, which is located under the skip bridge and over the hot-metal track, accommodates the furnace,-charging control equipment, the skip-hoist winch, etc. The materials are charged into the furnace through an improved-type distributor which is suitable for high top-pressure operation. The revolving hopper is 6 ft. 6 in. in diameter and is supported on three rollers. It is also held down by three rollers and guided by three side rollers. The small bell, which is in halves, is 7 ft. diameter. The distributor is driven by a direct-current motor through gearing. The small bell hoist is pneumatically operated by the cold blast, or, in emergency, by the compressed-air system. The large bell is a steel casting 15 ft. 6 in. in diameter and weighs 25 tons. The large hopper is 15 ft. in diameter at the top and is of cast steel in one piece. The large bell is operated pneumatically. The furnace-top structure provides access to a 55-ton trolley for removing the large bell and hopper during furnace relining; it supports the receiving hopper platform, bell beam platform and bleeder-valve platform. The 27 ft. diameter hearth of the furnace is in firebrick, approximately 14 ft. thick, and is contained by a hearth jacket. The ring wall is in carbon and the stack in firebrick. Eighteen copper tuyeres 6¼ in. in diameter are spaced around the furnace and are fed by a brick-lined bustle pipe of 3 ft. 6 in. inside diameter. The furnace stack is of riveted construction and is supported on the mantle ring, which, in turn, is supported by nine H-section columns which are of welded construction. For cooling the hearth, one set of hematite iron segments is provided inside the hearth jacket. Eleven rows of copper coolers are installed for the bosh and seven rows for the stack; they are all of the flat-plate type. The hearth is cooled by means of an 8-in. circle pipe, and the water is collected in a lower trough underneath the bustle main. A 14-in. circle pipe supplies water for bosh and stack cooling, and the overflow is collected in an upper trough above the bustle main.

HAWARDEN BRIDGE STEELWORKS.

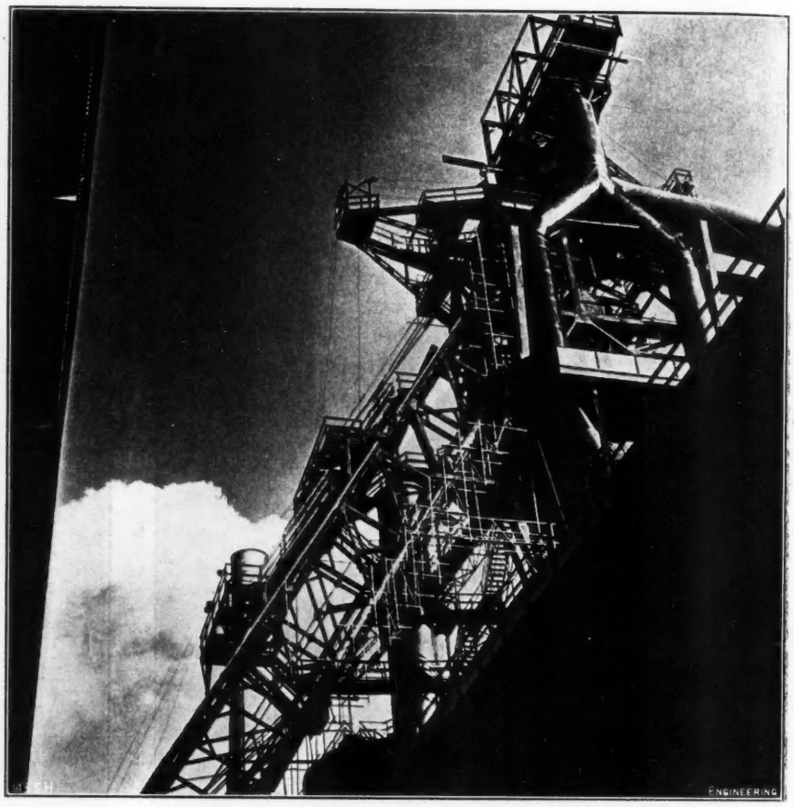


FIG. 4. SKIP HOIST AND TOP OF BLAST FURNACE

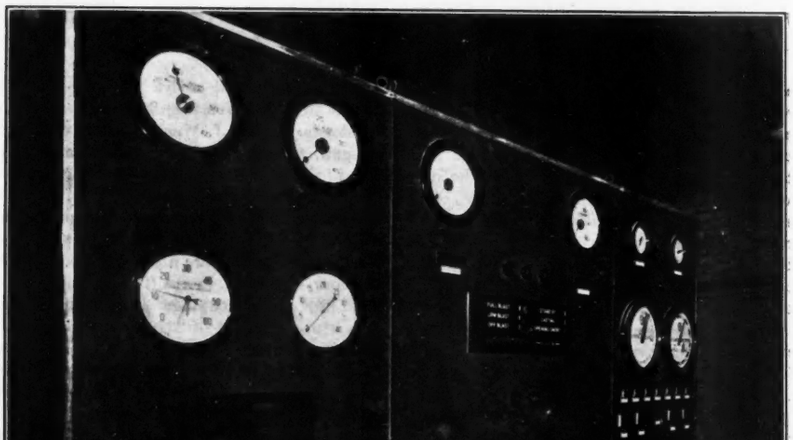


FIG. 5. BLAST-FURNACE PLATFORM INSTRUMENT PANEL.

THE INSTITUTE OF BRITISH FOUNDRYMEN.

THE jubilee of the foundation of the Institute of British Foundrymen occurs in April, 1954, and, to mark the event, the Council hope to publish a full narrative of the Institute's work during the 50 years of its existence. An encouraging feature of the Institute's activities is that the aggregate membership on April 20 was 5,017, compared with 4,917 on the corresponding date of 1952. In their annual report for the twelve months ended April 30, 1953, presented at the 50th annual conference, held in Blackpool, from June 16 to 19, the Council

HIGH-SPEED OIL-GROOVING MACHINE.

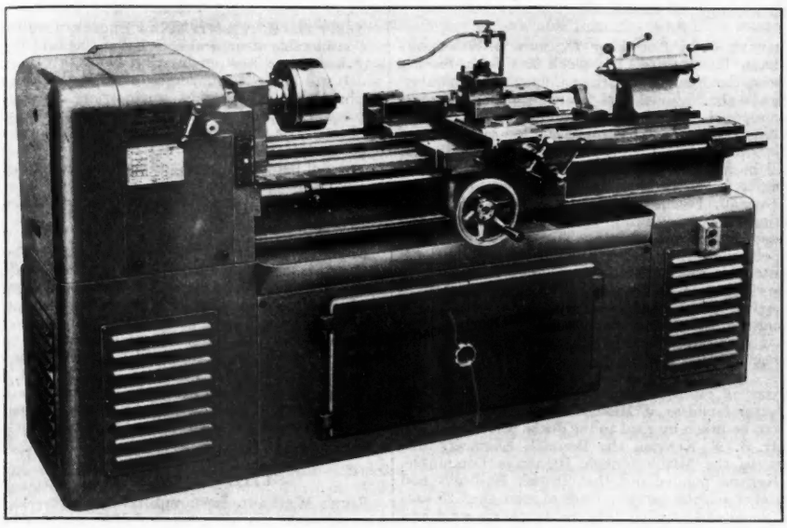


FIG. 1. OIL-GROOVING MACHINE.

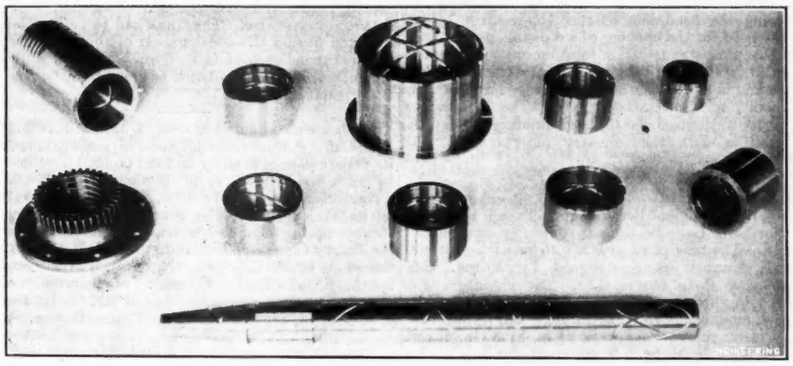


FIG. 2. COMPONENTS WITH OIL GROOVES MACHINED.

record with regret the death of 36 members. The Institute has always been fortunate in having a number of very active branches and it is interesting to note that a new section has been formed at Southampton and that it is hoped to establish another in the Northampton area. Moreover, as a result of negotiations and a ballot, it has been decided unanimously to amalgamate the Victoria Division of the Institute of Australian Foundrymen with the Institute. The Division is to be known henceforth as the Australian Branch (Victoria) of the Institute of British Foundrymen. Several of the matters mentioned in the report were again referred to at the annual banquet of the Institute, held at the Winter Gardens, Blackpool, on June 17. Sir William J. Larke, K.B.E., the E. J. Fox Medallist for 1953, in proposing the toast of the Institute of British Foundrymen, congratulated the Institute on having exceeded a membership of 5,000 and on the formation of the new branch in Australia. He advised the Technical Committee to continue its fruitful policy of undertaking joint investigations with other research organisations. In the course of his reply, the newly-elected President, Mr. E. Longden, said that the international exchange of technical papers had always been a feature of the annual conferences. The free discussion of mutual problems had obvious advantages and also helped to improve international relations. Among other toasts, that of the Guests, proposed by Mr. John Bell, who that morning, had been elected senior vice-president of the Institute for the year 1953-54, was acknowledged by Mr. F. Scopes, President of the Joint Iron Council and of the British Cast Iron Research Association.

HIGH-SPEED OIL-GROOVING MACHINE.

As a result of a large order for phosphor-bronze bushes with multiple helical oil grooves, both right and left hand, Trojan, Limited (motor manufacturers and general engineers), Trojan Works, Purley-way, Croydon, designed a machine capable of cutting any type of oil groove internally or externally on diameters up to 12 in. and over a length of barrel not exceeding 7 in. This machine will produce continuously, by a generating process, multi-start grooves of almost any number, with the use of the correct gears, and the grooving tool used is arranged so that it will cut on the return stroke if both right-hand and left-hand grooves are required. An additional feature of the machine is the fact that it can be set up for cutting splines up to 7 in. in length, the indexing in this case being set by hand. Due to the success and economy achieved by this machine in their own plant, where it has been operated by female labour at floor-to-floor times said to be greatly superior to any which could have been obtained on the conventional type of machine, Trojan, Limited, decided to start producing machines of this nature for the commercial market and they have appointed the Selson Machine Tool Company, Limited, Chase-road, London, N.W.10 (who are members of the "600 Group of Companies") as their sole agents at home and abroad.

The Trojan planning department, who were responsible for the development of the machine, directed their efforts toward a design which would be capable of cutting all types of oil grooves individually or mass-produced at the highest possible output rates. The prototype mechanism which they created was adapted to an old centre-lathe, and without modification to the original design it has proved sufficiently successful to enable it to be left in use on the production line. The machine which they have now produced is shown in Fig. 1, on this page.

In appearance it is very similar to a normal lathe. The bed is of the flat type, with wide guides at the back and front to support the saddle. The headstock spindle is driven by a 1½-h.p. motor with a speed of 1,430 r.p.m., mounted directly beneath the gearbox, and the drive is through a V-belt and worm gearing. A belt tensioner, which can be adjusted by hand, is fitted externally at the rear of the machine. The spindle itself can be indexed to any factor of 24 by disengaging a hand-operated dog-clutch. The change gearing drives a crosshead of the Scotch-yoke type, which is coupled directly to the saddle reciprocating shaft. This shaft is placed in the position of the lead-screw on a normal lathe; its stroke can be adjusted against a scale on the crosshead and locked by a nut. The plate shown at the front of the machine head in Fig. 1, with two fixing screws, has to be removed when this adjustment is made. The cover over the change gearing is hinged and swings back to give access, and beneath it is a micro-switch which isolates the current to the motor while the cover is off. The saddle is locked to the reciprocating shaft by the handle on the right of the saddle apron and its position is maintained by a locking stop-collar.

A splined spindle runs along the rear of the bed to provide the drive for operating a cam which is used to interrupt the travel of the tool by lifting it away from the cutting face at points where a groove is not required. Special cams can be fitted to cut eccentric grooves, and a tailstock can be used for long shafts. By disengaging the clutch and bringing a plunger into operation, which can move between the driving dogs and hold the spindle stationary, indexing can be obtained for producing splines of any number which is a factor of 24. The action of the machine is then the same as that of a shaping machine, the tool merely travelling up the outer surface parallel to the longitudinal axis of the workpiece. A removable sub-slide and angle guide-plate can be fitted at the rear of the saddle and can be adjusted to enable grooves to be cut at any included angle up to 30 deg. The cutting tool has a manual feed as on a lathe, the cross-traverse being driven by the hand-wheel at the front of the saddle. A steady rate of hand feed has proved satisfactory, due to the high speed at which the machine operates, but consideration has been given to an automatic feed which would cause the tool to move in after each complete cutting cycle has been completed.

The oil grooves produced on the machine are cut by the generating process, the workpiece rotating at a uniform speed while the saddle reciprocates; thus all the grooves are cut progressively in the same operation without stopping the machine, the result being a series of true helices. Fig. 2 illustrates some of the typical oil grooves that have been cut on the machine. The maximum diameter that can be swung over the bed and saddle is 14 in., and the maximum diameter admitted over the cross-slide is 8 in. Workpieces not exceeding 46 in. in length can be mounted between the centres. The spindle nose is arranged for a standard chuck; it is normally fitted with a Bernard chuck of 8½ in. diameter with a bore of 2½ in. The bore through the spindle is 1¼ in. and the spindle nose is bored No. 2 Morse taper. The oil-grooving machine has an overall length of 8 ft., a width of 3 ft. and a height of 4 ft.

"THE INSTITUTION OF NAVAL ARCHITECTS": ERRATUM.—On page 777, *ante*, in our report of the discussion on the paper by Mr. J. D. Farmer and Mr. K. C. Hales, on "The Insulation of a Refrigerated Cargo Ship," we quoted a statement by Mr. S. J. Duly to the effect that, in certain German ships, the adoption of the Munters process for maintaining insulation in a permanently dry condition had resulted in "a saving of 5 per cent. of the total capacity." Mr. Duly has since informed us that this should read "savings of up to 5 per cent." of the capacity.

NOTES FROM THE INDUSTRIAL CENTRES.

SCOTLAND.

IRON AND STEEL INDUSTRY IN SCOTLAND.—Scottish steel production in May improved to an annual rate of 2,491,600 tons as compared with 2,486,900 tons in April. In May of last year, the rate was 2,150,700 tons. Pig-iron production, however, continued to decline last month, being equivalent to 845,500 tons a year against 853,600 tons in April, and 904,300 tons in May, 1952. These figures reflect an improvement in deliveries of steel scrap, which has enabled the proportion of this material in the melting furnaces to be increased to around 53 per cent. of the metal charge.

SIX 210-TON STEEL CASTINGS.—Wm. Beardmore & Co., Ltd., Glasgow, have just completed the third of six large castings each requiring 210 tons of steel, the combined output of four melting furnaces. The castings are for die-forging presses, and have been ordered by an American firm working for the United States defence programme.

FLOOD DAMAGE IN ARGYLLSHIRE.—The County Engineer for Argyllshire has reported that damage to classified and unclassified roads, bridges, and water-supply installations, caused by recent rain floods, is estimated at 115,000*l*. The damage to the Ballachulish Reservoir and other water works is estimated at 15,000*l*. A special grant to cover the damage is being sought from the Ministry of Transport and the Secretary of State for Scotland.

EXPERIMENTAL DIESEL TRAIN.—An experimental Diesel train is being run by British Railways between Ayr and Dalmellington and Kilmarnock. The train can be operated with from one to three coaches. It has a driving compartment at each end, and a top speed of 45 m.p.h.

UNDERWATER SURVEY OF DESTROYER "MAILLÉ BRÉZÉ."—Naval and civilian divers engaged in the underwater survey of the French destroyer Maillé Brézé, which, as stated in these notes last week, sank off Princes Pier, Greenock, after an explosion in 1940, report that so far their examination shows that it would be possible to raise the wreck in one piece. The hull of the destroyer is embedded in sand, and it has been estimated that if it is eventually decided to raise the ship the lift would be one of about 4,000 tons.

SCOTTISH OLD MOTOR-CAR RUN.—The oldest car to take part in the Coronation Scottish Run on June 14, organised by the Dundee and Angus Motor Club, was a 1910 Wolseley. Thirty-two cars took part. Only one, a 1921 Renault, developed engine trouble, but it completed the course, three-quarters of an hour late.

CLEVELAND AND THE NORTHERN COUNTIES.

JUBILEE OF WALLSEND SHIPBUILDING FIRM.—This month marks the jubilee of the amalgamation of C. S. Swan & Hunter, Ltd., and Wigham Richardson & Co., Ltd., into the Wallsend shipbuilding firm of Swan, Hunter, & Wigham Richardson, Ltd. The firm was incorporated on June 15, 1903.

OIL-STORAGE INSTALLATION AT LACKENBY.—The Ministry of Works have approved a 661,000*l*. scheme by Shell-Mex & B.P., Ltd., for the construction of an oil-storage and bunkering installation at Lackenby, Yorkshire. It is expected that work on the scheme will commence this summer. There will be 20 tanks holding gas oil, fuel oil and marine Diesel oil. The largest tank will hold 9,250 tons of oil and the smallest 500 tons.

OPPOSITION TO EXTENSIONS TO MONKTON COKE WORKS.—Plans by the National Coal Board to extend the Monkton Coke Works, Co. Durham, to about twice their present size have had a mixed reception. Hebburn-on-Tyne Urban Council have approved the work, but the adjoining town of Jarrow has objected, on the grounds that there will be increased effluent and smoke, detrimental to the surrounding houses. The Ministry of Civil Aviation have objected to the erection of a new chimney which might be harmful to the proposed airport at Boldon, two or three miles away. A meeting has been arranged between the National Coal Board, the local authorities of Jarrow, Boldon and Felling, and the Ministry of Civil Aviation to discuss the objections to the plan.

EMPLOYMENT ON NORTH-EASTERN TRADING ESTATES.—The number of persons employed in factories on the Government-sponsored trading estates in the North-East region has reached the all-time record figure of 45,000. A year ago, the number was 42,159. More than 19,000 men are employed, or 2,000 more than 12 months ago.

DISPUTE OVER ROUTE OF LYNEMOUTH-WOODHORN MINERAL RAILWAY.—A deadlock has been reached between the Newbiggin Urban Council, Northumberland, and the National Coal Board regarding the route of a proposed mineral railway to link Lynemouth and Woodhorn collieries. The route selected by the Board is opposed by the Council, on the grounds that it would be harmful to amenities. The Board are not willing to adopt an alternative route put forward by the Council, because, it is stated, it would mean additional expense owing to steeper gradients and increased maintenance costs. The Council have said that although their scheme might mean additional expense, this was preferable to spoiling the amenities of the village. A meeting held between representatives of the Board, the Newbiggin Council, the Ministry of Agriculture, the County Council Land Agent and the County Planning Officer has failed to bring about an agreement.

ROADS IN MIDDLESBROUGH DOCK AREA.—The need for better facilities at Middlesbrough to allow heavy loads to be taken by road to the docks was emphasised by Mr. J. A. Kenyon, the Borough Engineer, in a report to the Middlesbrough Highways Committee. Mr. Kenyon pointed out that British Railways had prohibited vehicles carrying loads of more than 25 tons from using the crossing between Linthorpe-road and Sussex-street, Middlesbrough, whereas, in the past, loads of up to 100 tons had used the crossing, which was the only way of getting heavy goods by road to the docks. Mr. Kenyon urged the necessity of increasing the headroom at the Albert-street bridge and the need for the opening of a crossing, on demand, near Denmark-street. If a solution was not found, he added, trade would be taken away from Middlesbrough and heavy loads would be conveyed to Sheffield, Liverpool or Newcastle-on-Tyne. The Highways Committee authorised the Borough Engineer to discuss the position with the Ministry of Transport and British Railways.

GAS PLANT AT BERWICK-UPON-TWEED.—A new gas-making plant at the Berwick-upon-Tweed works of the Northern Gas Board was officially opened on June 16. The new plant consists of nine intermittent vertical chamber ovens designed by Messrs. Gas Chambers & Coke Ovens, Ltd. The chambers are arranged in three beds which form the retort bench, and each chamber is 15 ft. 2½ in. high and of approximately rectangular section, 8 ft. 2½ in. by 8⅝ in. at the top, and 8 ft. 2½ in. by 1 ft. 0½ in. at the base. The chambers are heated to approximately 1,300 deg. C. by the combustion of gas made in three producers built integrally with the chambers, the air for combustion being preheated in a recuperator by the products of combustion on their way to the main chimney. Each chamber will hold 2·3 tons of coal, and, depending on the temperature in the chamber, will carbonise this coal in 12 to 14 hours, producing coal gas at a calorific value of 540 B.Th.U. per cub. ft. At the end of this true carbonising time, steam is introduced into the bottom of the chamber, and passing through the hot coke forms water gas (calorific value approximately 300 B.Th.U. per cub. ft.) This steaming process allows the calorific value of the gas leaving the retort house to be adjusted to 475 B.Th.U. per cub. ft. Full use is made of electricity for power purposes, but where continuous operation is essential, stand-by steam drives are available. The plant will produce 500,000 cub. ft. of gas per 24 hours and arrangements have been made for extensions should they be found necessary.

LANCASHIRE AND SOUTH YORKSHIRE.

OUTLOOK IN SHEFFIELD WORKS.—While certain branches of the lighter industries of Sheffield show signs of some improvement, there is a feeling of apprehension in the heavy steel and engineering branches because new business is not being secured as readily as formerly. Present orders provide continuous employment, except where the shortage of skilled men halts the progress of semi-finished products through the shops. It is stated that it has been decided that no new appointments except those of skilled men must be made at present.

BEIGHTON COKE OVENS.—A new battery of 25 coke-ovens was lit on June 11 at the Brookhouse, Beighton, plant of the United Coke and Chemicals Co., Ltd. It replaces one that has been in operation for over 23 years, and will carbonise 170,000 tons of coal a year. The make of coke will be maintained at a high level, and the new plant will yield a larger supply of gas for Sheffield industry. The erection of the new battery by Simons-Carves Ltd. has been completed in the record time of twelve months.

SHEFFIELD UNIVERSITY'S NEW ENGINEERING BLOCK.—Considerable structural activity at Sheffield University includes a new engineering block, at Brookhill, which will house 270 undergraduates in the new civil, mechanical and electrical engineering departments. There will also be from 30 to 50 post-graduate research workers. The main laboratories will be devoted to experimental work in testing engineering materials, heavy and light structures and building materials, and in hydraulics and hydraulic machinery. Some of the mechanical laboratories may be in use in about a year's time.

FUEL TECHNOLOGY.—The Fuel Technology Department of Sheffield University has been pursuing research for four years to devise apparatus that would burn coal smokelessly and at the same time produce an atmosphere that would not affect steel being heated in low-temperature furnaces. A mechanical coal burner has now been evolved that will heat steel from cold virtually smokelessly. Professor R. J. Sarjant, head of the department, states that the new stoker, with its combustion chamber and special method of admitting air, has given results in advance of anything previously achieved.

THE MIDLANDS.

RIVER WELLAND IMPROVEMENT SCHEME.—In connection with the diversion of the River Welland that is being planned by the Catchment Board, British Railways (Eastern Region) have recently completed a new bridge that will carry their single line between North Drove and Weston, near Spalding, over the future water-course. The track had to be temporarily diverted during the construction of the bridge, which has five spans each of 54 ft. 6 in., and of the approach embankments, but the track has now been returned to its original alignment.

RUGBY ENGINEERING SOCIETY JUBILEE EXHIBITION.—In October, the Rugby Engineering Society completes its fiftieth year of activity and the Council have decided to mark this by holding, on September 24, 25 and 26, a conversazione and exhibition, the exhibition to show, as its major theme, the progress of engineering in Rugby during the half century. The Governors of the Rugby College of Technology and Arts have placed the whole of the College at the disposal of the Society for the period of the exhibition. Further information may be obtained on application to Mr. G. H. Paulin, Cottesloe, 14, St. Marks-avenue, Bilton, Rugby.

HIGH OUTPUT OF STEEL.—It is claimed that the Appleby-Frodingham steelworks of the United Steel Companies, Ltd., at Scunthorpe, are the first in the Commonwealth to have produced more than a million tons of steel in a year. The record was 1,000,857 tons in the twelve months ended May 30. It is hoped to raise further the annual output in the forthcoming year by continuing the 12,000,000*l*. development scheme.

SOUTH-WEST ENGLAND AND SOUTH WALES.

SWANSEA EAST-SIDE APPROACH ROAD.—The Mayor of Swansea, Mr. D. J. Fisher, opened the first stage of the new Swansea east-side approach road on June 11. It forms part of the 3,500,000*l*. scheme from Briton Ferry to Wind-street, Swansea, and includes the Neath River Bridge which will link up Swansea and West Wales with the main arterial roads of the country. It will avoid a 5½-mile detour through Neath when finished.

FURNACE AND PREFABRICATED BUILDING CONSTRUCTION AT CHEPSTOW.—The Fairfield Shipbuilding and Engineering Co., Ltd., Chepstow, are at present engaged on making more than 140 electric furnaces for the Aluminium Co. of Australia. The furnaces will be shipped to Adelaide within the next few months. Also being prefabricated at the same works is a building for the Docks and Inland Waterways Executive, to cost 250,000*l*. It will be erected at Southampton Docks and is a two-storey structure 930 ft. long and 160 ft. wide.

OBJECTION TO OPEN-CAST COAL PROSPECTING.—Brynmawr Urban Council have taken steps to stop proposals for the prospecting of 200 acres of land for an open-cast coal site. Their main objection was that such operations might interfere with the town's water supply, it being stated that the land concerned formed part of the town's catchment area. The National Coal Board, at Cardiff, it was reported at a meeting of the Council, were proposing to ask the Ministry of Works to serve notice of entry for prospecting.

NOTICES OF MEETINGS.

IT is requested that particulars for insertion in this column shall reach the Editor not later than Monday morning in the week preceding the date of the meeting.

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS.—*Bournemouth Branch:* Tuesday, June, 30, 8.15 p.m., The Grand Hotel, Firvale-road, Bournemouth. "Modern Fixing Practice," by Mr. R. P. Dunn. *North London Branch:* Wednesday, July 1, 7.45 p.m., The Queen's Head Hotel, 677, Green-lanes, Harringay, N.4. "Safety Regulations," by Mr. F. Clarke.

ROYAL SANITARY INSTITUTE.—Thursday, July 2, 10.15 a.m., Town Hall, Walsall. (i) "Land Use in Walsall, with Special Reference to Slum Clearance and Reclamation of Derelict Land," by Mr. M. E. Habershon; and (ii) "Some Avenues to a Better Environment," by Mr. James Green.

TRADE PUBLICATIONS.

Variable-Speed Drives.—Carter Gears, Ltd., Thornbury-road, Bradford, have issued a catalogue giving specifications of their hydraulic infinitely-variable speed gears, available in a range from ¾ h.p. to 22 h.p. The catalogue includes a technical description of the working principle of the Carter gear and surveys typical applications.

Display Models.—The Model Department of Hunting Aerosurveys, Ltd., 6, Elstree-way, Boreham Wood, Hertfordshire, have issued a leaflet illustrating examples of their display, topographical, and engineering models.

Aluminium-Alloy Buildings.—We have received from Structural and Mechanical Development Engineers, Ltd., Slough, Bucks. (of the Associated Light Metal Industries Group) their brochure on "Alframe" prefabricated aluminium-alloy buildings, which are primarily intended for export and, under normal conditions, require no weather protection, such as painting.

Enamelled Winding Wires.—We have received a leaflet from British Insulated Callender's Cables, Ltd., describing their new series of "Fifty-Three" enamelled winding wires, which are supplied in a full range of conductor sizes from 0·002 in. to 0·080 in., with an alternatively available fine or medium thickness of covering conforming to corresponding types in Table 7 of B.S. 1844 : 1952.

Documentary and Instructional Films.—The Petroleum Films Bureau, 29, New Bond-street, London, W.1, have issued a list of 35-mm. and 16-mm. documentary and instructional films, including such subjects as petroleum, aviation and motoring, power and engineering, and agriculture. The films are available *gratis*, on payment of return postage, to approved societies.

Air Compressors.—We have received leaflets from Holman Brothers Ltd., Camborne, Cornwall, describing their T.60R stationary air compressor, with a displacement of 526 cub. ft. per minute at a pressure of 100 lb. per square inch at maximum speed; and their tractor link-mounted air-compressor unit with a displacement of 70 cub. ft. per minute at a pressure of 100 lb. per square inch.

Compressed-Air Farm Equipment.—B.E.N. Patents, Ltd., High Wycombe, Buckinghamshire, have issued a leaflet describing briefly their portable and stationary air compressors and accessories for general use on farms.

Consumer's Service Units.—Details of the design of their latest types of consumer's service units, which are suitable for use on 250-volt single-phase circuits with currents up to 60 amperes, are given in a booklet received from British Insulated Callender's Cables, Ltd., Norfolk-street, London, W.1.

Combustion Control.—Bailey Meters and Controls, Ltd., Moorgate Hall, Moorgate, London, E.C.2, have issued a leaflet illustrating the principles and the various components of their air-operated combustion control equipment for oil-fired and gas-fired boilers.

Air Hoists.—We have received from Metalmacs, Ltd., Much Park-street, Coventry, a leaflet showing details of the "Simlift" air hoists. There are four models of this hoist, all of which operate on an air pressure of 80 lb. per square inch and have capacities of 2, 3½, 6 and 10 cwt. The up-and-down movement of the hoist is controlled by a twist-grip type of lever and two speeds can be obtained in each direction.

Gas-Fired Furnaces and Gas Producers.—We have received three illustrated leaflets from the Incandescent Heat Co., Ltd., Cornwall-road, Smethwick, Birmingham. One describes an automatic gas machine for generating hot gas from solid fuels, intended mainly for firing industrial furnaces. A second leaflet describes the Incandescent gas carburising system which, it is claimed, is more efficient and economical than the conventional box carburising system. The third leaflet gives brief particulars of Incandescent standard gas-fired furnaces for heat treatment within the range 600 deg. to 1,000 deg. C.

BRITISH STANDARD SPECIFICATIONS.

THE following publications of engineering interest have been issued by the British Standards Institution. Copies are available from the Sales Department of the Institution, 24, Victoria-street, London, S.W.1, at the prices quoted at the end of each paragraph.

Presentation of Numerical Values.—A new publication, B.S. No. 1957, covers the presentation of numerical values (fineness of expression and rounding of numbers). Its purpose is to promote the adoption of a consistent procedure in the presentation and interpretation of numerical values, particularly in regard to the number of figures to be used and the procedure for rounding. The values may represent technical data, experimental results, or requirements in specifications and drawings, or they may take the form of tables. General principles and working rules relating to the different aspects of the subject are set out and illustrated by examples. The compilers of the publication express the hope that it will be of general use in scientific work. [Price 3*s.*, postage included.]

Brass Tubes for General Purposes.—A specification, B.S. No. 885, concerned with 70 : 30 brass and aluminium-brass tubes for general purposes has been issued to replace the two specifications Nos. 885 and 886 published in 1940. In the revised specification, the requirements for both as drawn and annealed tubes, previously dealt with separately, have been incorporated in one specification. The optional addition of tin to the 70 : 30 brass has been deleted and the 2 per cent. aluminium brass has been included as an additional alloy. Many clauses have been re-drafted and certain modifications made to the tests required and the tolerances allowed. An appendix contains a table of sizes of 70 : 30 brass and aluminium-brass pipes for the petroleum industry. [Price 2*s.* 6*d.*, postage included.]

Solid-Drawn Copper and Copper-Alloy Tubes.—Another revision, B.S. No. 378, covers solid-drawn copper and copper-alloy tubes for condensers, evaporators, heaters and coolers. The specification was first issued in April, 1930, and was last revised in February, 1941. This previous edition of 1941 was concerned with tubes of 70 : 30 brass and 70 : 29 : 1 Admiralty mixture (in which the 1 per cent. is tin). The present edition includes, in addition to these alloys, tubes of copper, aluminium brass (2 per cent. of aluminium), copper-nickel alloy and aluminium bronze (7 per cent. of aluminium). The outside diameters of the tubes covered by the specification range from 0·25 in. to 1·50 in. inclusive, and the specification opens with clauses regarding manufacture and the composition of the materials employed. Subsequent clauses deal with chemical analyses and hydraulic, mechanical and mercurous nitrate season-cracking tests. The requirements for tubes for screwed glands, and screwed glands for condensers have been omitted from the present edition and will be covered in a separate specification which is in course of preparation. [Price 2*s.* 6*d.*, postage included.]

Code of Practice for the Structural Use of Steel Tubes in Buildings.—The Council for Codes of Practice for Buildings, Construction and Engineering Services, Lambeth Bridge House, London, S.E.1, have now issued, in final form, Code No. 113.201, dealing with "The Structural Use of Steel Tubes in Buildings." The Code has been drawn up by a committee, convened on behalf of the Council, by the Institution of Structural Engineers, and the present publication is a revision, following the comments received, of the draft Code previously issued. In the Code are set out recommendations for the design, fabrication and erection of steel tubes used in any part of a building, either by themselves or in combination with rolled-steel sections. It deals with the quality of the materials used, the permissible stresses and the methods of calculation which may be employed. It does not apply to steel scaffolding. In recent years the rapid advances in welding technique have increased the possibilities of using tubes in structural work, and much practical experience has been gained. The new Code is mainly concerned with construction having welded connections, and recommendations regarding the types of welded connection and the permissible stresses therein are given. It may also be used where other efficient types of connection are employed. The Code carries the usual warning that, in the present abnormal conditions, it may not be practicable to carry out all the recommendations put forward. [Price 5*s.*, postage included.]

MODEL OF M.S. "AURIS" GAS TURBINE.—The Anglo-Saxon Petroleum Co. Ltd. has presented to the Science Museum, South Kensington, London, S.W.7, a sectioned scale model of the 1,200-b.h.p. gas-turbine installation in their M.S. Auris. This oil tanker, of 12,250 tons deadweight carrying capacity, is the first merchant vessel in the world to be provided with gas-turbine propulsion.

PERSONAL.

H.R.H. THE DUKE OF EDINBURGH has graciously accepted honorary fellowship of the Institute of Welding, 2, Buckingham Palace-gardens, London, S.W.1.

SIR RONALD GARRETT has been re-elected chairman of the General Committee of Lloyd's Register of Shipping, 71, Fenchurch-street, London, E.C.3.

MR. E. T. NORRIS, M.I.E.E., M.I.Mech.E., has been appointed consulting engineer to Ferranti Ltd., Hollinwood, Lancashire, as from July 1.

MR. A. W. MCMURDO, M.B.E., B.Sc., A.M.I.C.E., for the past three years assistant district engineer, British Railways, Western Region, Plymouth, has been transferred to Paddington as assistant engineer, London district.

MR. W. BULLOCH, Assoc. Eng., A.M.I.Mech.E., has been appointed to control all the activities of the hydraulic and mechanical materials-handling department of B.V.C. Industrial Constructions Ltd.

CAPTAIN R. T. PAUL, C.B.E., R.N. (ret.), A.M.I.E.E., commercial manager of the equipment division of Mullard Ltd., has been appointed a director of Telcon Telecommunications Ltd., by Mullard Ltd., in place of DR. D. B. FOSTER, who has resigned from the board owing to pressure of work in other directions.

MR. C. J. CHAPLIN, M.B.E., B.Sc., A.M.I.C.E., assistant engineer (works maintenance), British Railways (London Midland Region), is retiring on account of ill health.

MR. G. E. SMITH, M.A. (Cantab.), has been appointed contracts manager, Brush Bagnall Traction, Ltd., Loughborough.

MR. P. W. HOWARD, managing director of the British Tyre and Rubber Co., Ltd., is succeeding Mr. J. H. LORD, director of the Dunlop Rubber Co., Ltd., as President of the Federation of British Rubber Manufacturers' Associations.

MR. F. M. DIMMOCK, head, equipment department, British Broadcasting Corporation, is to retire on October 18 after 28 years of service. MR. E. C. DREWE, assistant head, research department, will succeed Mr. Dimmock from October 1, when MR. A. B. HOWE, research consultant, will succeed Mr. Drewe as assistant head, research department. MR. R. A. BROWN has been appointed assistant head, building department, as from June 1.

MR. J. ROY GORDON, B.Sc., has been elected vice-president and general manager, Canadian operations, of the International Nickel Co. of Canada, Ltd., in succession to the late MR. R. LESLIE BEATTIE.

MR. JOHN FORD, Midlands manager, Paterson Hughes Engineering Co. Ltd., Bedford House, Bedford-street, Strand, London, W.C.2, has been appointed to the board. The firm's Midlands office is now at 3, Highfield-road, Edgbaston, Birmingham, 15. (Telephone: Edgbaston 1639.)

MR. J. T. RITCHIE has been appointed sales manager and local director of Aveling-Barford Ltd., Grantham, in succession to his father, MR. C. J. RITCHIE, who is retiring. MR. E. R. HOWLETT is also retiring from his directorship. MR. N. C. EARLL is to be works manager.

MR. C. E. WRAGG, sales manager of Kayser, Ellison and Co. Ltd., Carlisle Steel Works, Sheffield, has been elected a local director of the company.

MR. G. J. CORSON, A.M.I.E.E., has been appointed manager, traction division, Crompton Parkinson Ltd., Chelmsford, as from July 1, in succession to MR. F. H. BEASANT, who is joining the board of the Anti-Attrition Metal Group of Companies.

MR. A. R. DRIESSEN, O.B.E., commercial manager of the Indian Cable Co. Ltd., has been appointed chairman and managing director in succession to MR. D. J. MCINTOSH, who has retired.

MR. G. W. ROBINSON, of 47, Ullswater-avenue, Acklam, Middlesbrough, has been appointed to represent Jenolite Ltd., 13-15, Rathbone-street, London, W.1, in the North-Eastern area.

MR. R. F. LOCKYER has been appointed sales manager for the Ainsbury Group of Companies, covering the Midlands and Southern England.

L. RUSBY & CO., National Employers House, 9, Quebec-street, Leeds, 1, have been appointed representatives, in Yorkshire, of the Electro Dynamic Construction Co., Ltd., St. Mary Cray, Kent.

MR. K. W. MACNEE, M.A., B.Sc., A.M.I.Mech.E., 238, London-road, Twickenham, Middlesex (Telephone: POPesgrove 1194) has joined Flexibox Ltd., as technical representative for the London and Home Counties area.

The new address of the Scottish area office of WILD-BARFIELD ELECTRIC FURNACES LTD., Elecfurn Works, Watford By-pass, Watford, Hertfordshire, is 147, Bath-street, Glasgow, C.2. (Telephone: Douglas 8839 is unaltered.)

EXHIBITS AT THE BRITISH INSTRUMENT INDUSTRIES EXHIBITION.

(*For Description, see Page* 807.)

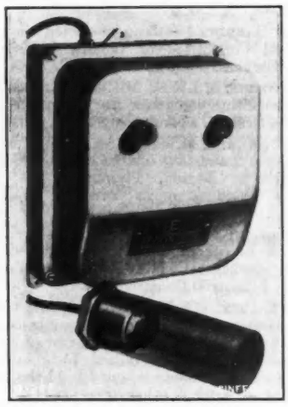


FIG. 2. FURNACE-CONTROL UNIT; ELCONTROL LTD.

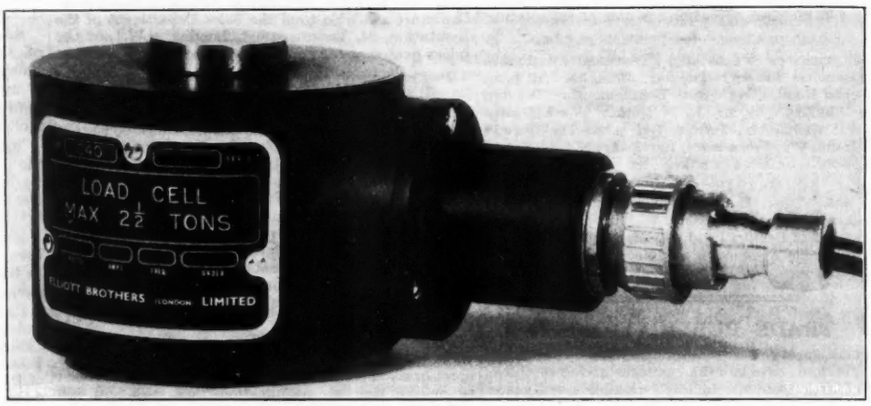


FIG. 3. LOAD CELL; ELLIOTT BROS. (LONDON), LTD.

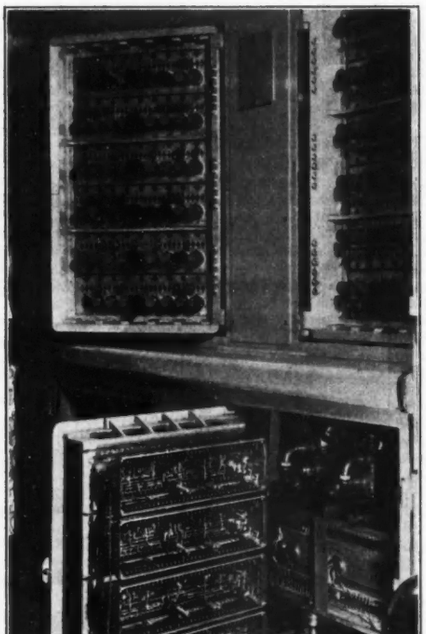


FIG. 4. ELECTRONIC DIGITAL COMPUTER; FERRANTI, LTD.

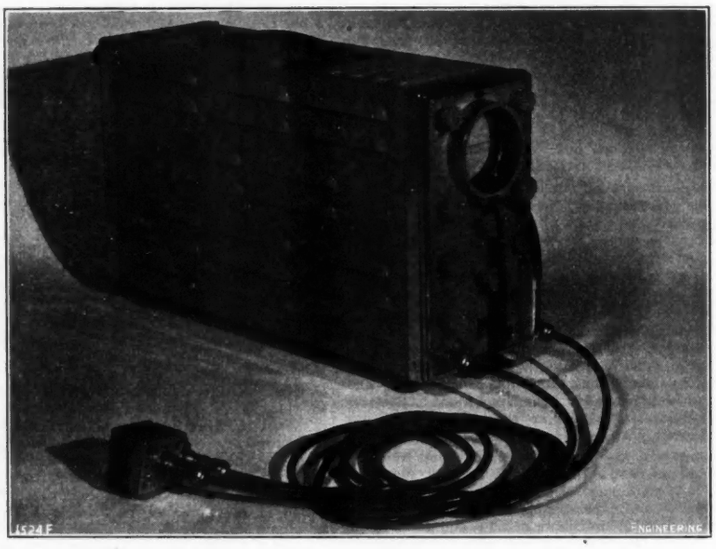


FIG. 6. MINIATURE ULTRASONIC FLAW DETECTOR; KELVIN & HUGHES, LTD.

FIG. 5. MINIATURE LINK TESTING AMMETER; GENERAL ELECTRIC CO., LTD.

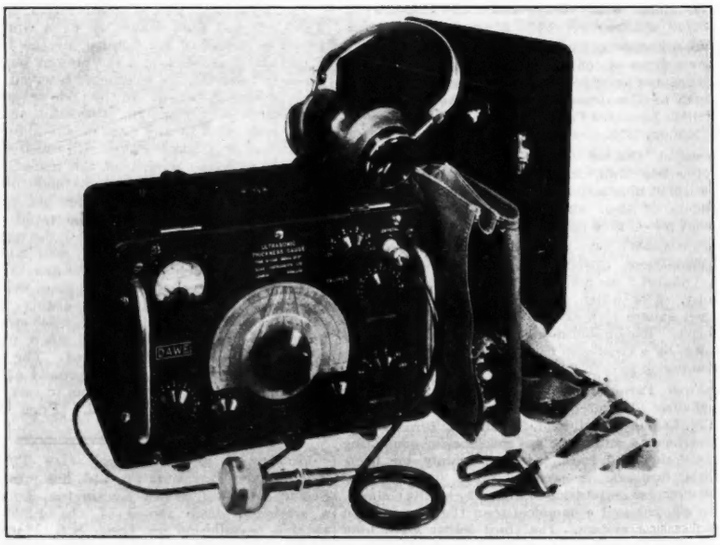


FIG. 7. ULTRASONIC THICKNESS GAUGE; DAWE INSTRUMENTS, LTD.

ENGINEERING.

35 & 36, BEDFORD STREET, STRAND, LONDON, W.C.2.

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TIME FOR RECEIPT OF ADVERTISEMENTS.

Classified advertisements intended for insertion in the current week's issue must be received not later than first post Monday.

"Copy" instructions and alterations to standing advertisements for display announcements must be received 16 days previous to the date of publication, otherwise it may be impossible to submit proofs for approval.

The Proprietors will not hold themselves responsible for advertisers' blocks left in their possession for more than two years.

INDEX TO VOL. 174.

The Index to Vol. 174 of ENGINEERING (July-December, 1952) is now ready and will be sent to any reader, without charge and postage paid, on application being made to the Publisher. In order to reduce the consumption of paper, copies of the Index are being distributed only in response to such applications.

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ENGINEERING

FRIDAY, JUNE 26, 1953.

VOL. 175. No. 4561.

TRANSPORT IN 1952.

WHETHER or not the British Transport Commission and its executives did well in 1952 is a question of faintly academic interest, even though the report and statement of accounts and statistics* for that year have been published with commendable speed, considering the magnitude and ramifications of the organisation. The future of British transport is now in the air, pending the formulation of a new policy and its approval by the Ministry of Transport under the terms of the Transport Act, 1953. The fact is, however, that there was a revenue surplus of 8,400,000*l.* for the year, though in the last few months the Commission were working at a loss owing to the lag in increasing the charges to offset rises in transport costs. The possible outcome of the latest Transport Act on the organisation of British Railways has already been discussed in its engineering aspects in two articles in these columns recently.

The capital investment permitted to the Commission continued to be controlled by the Government during the year. The main-line railways were allowed 76,600,000*l.*, and London Transport 7,200,000*l.* London Transport spent practically the whole of the permitted total, but the Railway Executive expenditure fell short by 6,800,000*l.*, mainly in the rolling-stock programme. This was due, as in 1951, to shortages of materials, particularly steel; Government allocation of steel was re-introduced on February 4, 1952. The allocation to the railways up to the end of March was 20 per cent. below requirments, and this level of reduction continued, more or less, throughout the year. The construction of new rolling stock suffered in consequence, since it was necessary to allow sufficient steel for repairs, relaying of track, and essential new works, covering both normal wastage and maintenance work deferred by war-time economies. The Commission point out that the policy of "make-do-and-mend" which has been the inevitable result of capital investment restrictions has proved harmful to economy and efficiency. Thus, for example, it has been necessary, once again, to resort to the expedient of repairing life-expired carriages, many of them between 40 and 50 years old. The proportion of passenger-carrying vehicles under and awaiting repairs during the summer of 1952 rose to a maximum of 7·5 per cent. of the stock, compared with 6·9 per cent. in 1951, no doubt due, in part, to the burden of the old carriages. The corresponding figure for wagons also rose.

A review of the position regarding automatic train control is given in the report. The Railway Executive have been engaged on experiments since 1948. A number of technical difficulties prolonged the experiments, but early this year large-scale trials of new equipment began between New Barnet and Huntingdon on the East Coast main line. The adoption of new equipment as standard will depend on the results of these trials, and a final decision will be subject to the chief inspecting officer of railways, of the Ministry of Transport, being fully satisfied with the tests and the design of the apparatus.

Since 1948 the problems of alternative forms of railway motive power have been under consideration, though any recommendations or suggestions must clearly depend on capital investment policy. The annual report states that the Commission received in January, 1952, a report from the Railway Executive on the estimated future balance of advantages between various forms of motive power. "Whilst answers to all the problems of future motive power policy," the annual report continues, "are far from solution, several important decisions have been taken and others are under close consideration." Most of the large Diesel locomotives are being grouped together in the Southern Region in order to concentrate maintenance under an experienced staff. The possibility of converting an important length of main line exclusively to Diesel traction is also being considered.

The use of Diesel traction for shunting has made steady progress on British Railways in recent years. Fresh scope for the employment of Diesel power is now envisaged in passenger trains, on the multiple-unit principle. For secondary passenger services this form of traction is considered to have advantages in economy, comfort and speed as compared with the conventional steam train. The Railway Executive are adopting a modern design which consists, basically, of two-car or three-car train sets, which can be coupled together, where the traffic is sufficient, and operated under the control of a single driver. A number of these sets are to be built, and the Commission have approved an expenditure of 500,000*l.* This new Diesel service is to be introduced first in the West Riding of Yorkshire. A study is also being undertaken of the use of multiple-unit Diesel trains in certain suburban areas where the heavy capital cost of electrification cannot be justified under present circumstances, but where improved facilities are required and there is considered to be scope for the development of traffic. Gas-turbine locomotives, of which two are in service on British Railways, are still being examined. The questions remaining to be solved, the report states, include the high first cost of these

* *British Transport Commission: Fifth Annual Report, Statement of Accounts and Statistics, for the year ended 31st December*, 1952. H.M. Stationery Office. [Price 10*s.* 6*d.* net.]

prototypes, the future relationship of coal and oil prices, and the balance of advantages, from a national point of view, as between imported oil and home-produced coal. The Commission are in communication with the Ministry of Fuel and Power in regard to the construction of an experimental coal-burning gas-turbine locomotive sponsored by the Ministry.

In the civil engineering departments of the railways several technical advances are recorded. Promising results are said to have been obtained from four experimental schemes for the mechanisation of day-to-day length-gang maintenance to reduce costs and obtain a higher standard of maintenance. Investigations were continued on the preservation of steelwork in tunnels by cement gunning; underground corrosion of metal pipes; weatherproofing of sheet-metal building material; supersonic testing applied to rail welding and structural defects; the interaction between wheel and rail, etc. In the railway research organisation the many problems investigated included the cleaning of locomotives and carriages, stresses in bridges, continuous brakes for freight trains, the effect of speed and superheat on locomotive-cylinder efficiency, and the prediction of rail life on the basis of traffic and speed. Research and development work is also carried out by London Transport, the Road Haulage Executive, and the Docks and Inland Waterways Executive. Work of this kind, directed towards economy and efficiency of operation in all branches of British transport, is doubly important in view of the major restriction on capital investment.

FOOD ENGINEERING.

THE need for the scientific investigation of food is perhaps more important in a predominantly industrial country, like Britain, than in those less densely populated areas where most of the world's foodstuffs are grown. The persistence of rationing, years after the end of the war, is an unpleasant reminder of Britain's dependence on imported food and should equally be an incentive to intensify the production of home-grown food and to utilise imported food with the utmost economy. In both these directions, problems arise on a national scale and it is fitting, therefore, that they should be the subject of Government-sponsored investigation by the Department of Scientific and Industrial Research. A further point of justification, naturally, is that problems of vital national interest commonly demand long-term studies which private bodies have not always the funds or the qualified staff to undertake.

The food investigation laboratories were among the earliest establishments of the Department of Scientific and Industrial Research. Their progress has been marked by researches which have often been of fundamental importance, and always of the quality to merit the international reputation which these laboratories now enjoy. The general scope of their activities, dictated by the constant urge towards economy in the use of food, has been in the direction of food preservation in the widest sense of that term, involving not only the obvious processes of refrigeration and storage, but also the biochemistry and biophysics which point the ways to long-term improvements in conservation treatments. How profitable such basic research can become in time is implied in the latest annual report* of the Food Investigation Board, where attention is prominently drawn to the inclusion of two distinguished representatives of industry—Dr. H. J. Gough and Mr. H. W. Cremer—in the Joint Committee of the Food Investigation Board and of the Ministry of Food which was set up in 1951, under the chairmanship of Professor A. W. Scott of the Royal Technical College, Glasgow, to advise on the engineering and physics problems encountered in those two Government organisations and in three research associations which are concerned with food processing.

The Committee are extremely conscious of the physical and mechanical science aspects of food research and development, emphasising that research in this field offers opportunities for creative work and does not consist merely of servicing activities ancillary to biology. It is of interest, therefore, to exemplify from the Report how engineering research is dealing with food production and processing at the organisation's laboratories. Before doing so, however, it may be as well to recall that the practical and applied research work on food falls naturally into three major divisions, concerned, respectively, with fish, vegetable and animal foods, and their associated and secondary products. For each division there is one main and one subsidiary laboratory, both appropriately situated with respect to the product with which they are especially concerned. Thus, the investigation of fish and fish products is centred at the Torry Research Station at Aberdeen, to which a substation at Hull, known as the Humber Laboratory, has been added recently to facilitate studies of the drying and curing of fish, as well as to assist with problems arising from the large distant-water fishery which is now mainly concentrated at the Humber ports. The principal laboratory of the fruit, vegetable and plant products division, situated at Ditton in the midst of a fruit-growing region, is similarly supplemented by a laboratory at Covent Garden, London, where problems of storage and transport can be studied at first hand on a comprehensive scale. Finally, and in some respects of the greatest importance, is the Low Temperature Research Station at Cambridge, with which is associated a subsidiary laboratory at Smithfield Meat Market in London. The former is responsible for the more fundamental research in general biochemistry and biophysics, as well as for studies directed specifically towards meat, poultry, eggs, and cured produce, among which bacon figures prominently. Here again the establishment at the great London market permits the very necessary contact with practical aspects of the transport, large-scale treatment and retail distribution of the products concerned.

As might be expected, many of the obvious applications of engineering and physics in scientific food treatment are directly or indirectly connected with refrigeration and cold storage. In the case of fish, a considerable investigation is in progress at present to provide data for the design of more effective and efficient freezing plant than is in general use. The experimental equipment for this work at the Torry Station includes an air-blast freezer. Briefly, this is a closed-circuit wind tunnel in which air of variable humidity, cooled by passing over the finned-tube evaporator of an ammonia refrigerating plant, is circulated at speeds up to 50 ft. per second round fish exposed in open trays. Other experiments are concerned with methods of freezing fish at sea, in which connection it may be remarked that the Station has a motor fishing vessel for practical work at sea, and also has on order a new research trawler, with Diesel-electric propulsion, cold stores, quick-freezing plant and laboratory accommodation.

Scope for physics research occurs in the processing of fish by smoke-curing, air-drying and vacuum-drying, not only as regards the effects of the processes themselves but, perhaps more extensively, in the design and operation of instruments for measuring such effects and controlling the processes in order to achieve reliable and reproducible data for the subsequent design of industrial plant. Much the same, though with less emphasis on refrigeration, is true of meat and poultry. An example from the programme of the meat products division shows how traditional methods of bacon smoking can be improved upon, in respect of consistency and speed, by the use of scientific equipment, by which air-flow, temperature, humidity and smoke concentration are all controlled. In the case of fruit and vegetables, opportunities for physics and engineering investigations are presented by storage and preservation problems, while refrigeration controlled within narrow limits again assumes importance. The Ditton Laboratory has recently begun to operate a mobile refrigerated store, mounted on a trailer, for pre-cooling and storage experiments which need to be carried out, or at least started, on the production site as early as possible after the commodity is harvested.

If the examples just cited represent, as they obviously do, only a very small proportion of the total activities of the Food Investigation Board's organisation, it is perhaps fair to say that the advisory committee specially concerned with engineering and physics in relation to food was set up less than two years ago, so that its influence on the research programmes has hardly yet had time to become effective. What is abundantly clear, less from these few examples than from the common knowledge of technical workers of experience within the food industries, is that whole groups of outstanding engineering and physical problems in the food-producing, transporting, vending, processing and packaging industries are at present unconsidered by any of the food investigation research programmes. It is no detraction at all from the essential character of the fundamental studies now in progress—which engineers are among the foremost to acknowledge—to emphasise the potentialities of food engineering research and to suggest that the Joint Committee should not be content with advisory status, but should advocate with urgency a wider examination of the contributions which engineering and physics can offer to the food industries in this country.

* *Food Investigation*, 1952. Department of Scientific and Industrial Research. H.M. Stationery Office, York House, Kingsway, London, W.C.2. [Price 2s. net.]

NOTES.

THE IRON AND STEEL CORPORATION OF GREAT BRITAIN.

THE second annual report of the Iron and Steel Corporation of Great Britain—the directing organisation of the industry during its period of nationalisation—was issued on June 17. It covers the twelve months ended September 30, 1952, which was the first full financial year of the Corporation's operation. As the Corporation will be superseded shortly by the new Board set up under the Iron and Steel Act, 1953, this report may also be the last, though it would appear preferable that they should be allowed to prepare their own account of their stewardship down to the actual "divesting" date. The report shows that the gross sales of the publicly-owned companies totalled 773*l.* millions, including inter-company transactions, or 618*l.* millions when these are excluded. The manufacturing and trading profit amounted to 64·4*l.* millions after charging all expenses, etc., including 27·1*l.* millions for depreciation, but before deducting interest and taxation charges. It is stated that about half of the profits were derived from the normal iron and steel activities of the companies, the rest being due to such arisings as export premiums and book profits on stocks, due to rising prices. Taxation paid during the year amounted to nearly 38*l.* millions. Capital expenditure continued at a high level, and a programme of development for the next five years was drawn up, involving an estimated outlay of 263*l.* millions. It is estimated that the total expenditure on replacement, rebuilding and new construction will probably approach 350*l.* millions. The production of ingots and metal for castings in 1952 amounted to 16,418,000 tons, a highly creditable result, which, as the report points out, owed much to the more plentiful supplies of

pig iron coming from the new and rebuilt blast furnaces. The report is obtainable from H.M. Stationery Office, York House, Kingsway, London, W.C.2, at the price of 3*s.* 6*d.* net. The annual accounts are published separately and may be obtained from the offices of the Corporation, 1, Chester-street, London, S.W.1; the price is 16*s.* 6*d.*, including postage.

DELTA-WING AIR-LINER PROJECT.

Some preliminary details of a projected delta-wing trans-oceanic air-liner, to be known as the Atlantic, have been given by the designers, Messrs. A. V. Roe and Company, Limited, Greengate, Middleton, Manchester. It is designed to carry 94 to 113 passengers at a cruising speed of over 600 m.p.h., at 40,000 ft., and will enable the journey between London and New York to be carried out, non-stop, in 6½ to 7 hours westbound, and 5 to 5½ hours eastbound. The manufacturers estimate that the direct operating cost on the North Atlantic route should be between 7*d.* and 10*d.* per ton-mile, according to the allowances made for wind, and claim that economical operation should be possible over stages ranging from 1,500 to 4,000 statute miles, the corresponding payloads varying from approximately 20 tons to 10 tons. The maximum take-off weight is expected to be approximately 200,000 lb. The overall dimensions are: length, 145 ft.; wing span, 121 ft.; and fuselage diameter 12·5 ft. Power will be provided by four turbo-jet engines, arranged in pairs and completely enclosed in the wing roots. The type of engine has not been finally selected, but the present performance and cost estimates are based on Bristol Olympus engines, which, it may be recalled, are to be fitted in the smaller Avro Vulcan delta-wing bomber, from which this transport project has developed. The fuselage, a light-alloy stressed-skin structure, will be built in four main units—the nose, containing the flight deck, accommodating a crew of three, the front centre section, the centre section and the rear section. The centre-section fuselage is integral with the torsion-box structure of the centre-section wing, which embraces the centre and rear spars, extending to a transport joint outboard of the undercarriage bay. The centre section of the front spar, which is joined at the fuselage sides, is integral with the front centre-section fuselage. The fin is built as a separate unit. Outboard of the undercarriage bays, the wing is a rigid light-alloy structure in which new construction methods will be employed. The control surfaces will be aerodynamically balanced and operated by duplicated irreversible electro-hydraulic power units, artificial "feel" being provided. The main undercarriage units will be of the bogie type with a single shock-absorbing strut. Fuel will be carried in flexible wing tanks outboard of the engines. The cabin, divided into forward, centre and rear compartments, with capacities of 1,550 cub. ft., 1,000 cub. ft., and 3,340 cub. ft., respectively, will be pressurised to a maximum of 8·8 lb. per square inch above atmosphere, ensuring a cabin altitude of about 8,000 ft. when the aircraft is flying at 45,000 ft. A lounge bar is provided in the centre of the fuselage. The galley is between the forward and centre cabins, and toilets are provided at the rear of the aircraft. Backward-facing seats are envisaged. Below the floor are forward and rear baggage and freight holds, with capacities of 1,260 cub. ft. and 670 cub. ft., respectively. In planning the Atlantic air-liner, the Avro company have been assisted by the British Overseas Airways Corporation. No orders, however, have so far been placed for the aircraft. The company believe that it should be possible to fly a prototype Atlantic aircraft within three years of the placing of an order.

HYDRO-ELECTRIC DEVELOPMENTS IN SCOTLAND.

The Gaur scheme of the North of Scotland Hydro-Electric Board was formally inaugurated by the Prime Minister of Australia (the Rt. Hon. R. G. Menzies) on Saturday, June 20. The scheme will provide the barren waste lands of the Moor of Rannoch with some economic value, since, although they are not crossed by a road, they are spanned by two overhead lines through which power is transmitted to Oban, Kinlochleven and Fort William. The main works consist of a dam, pipeline, fish-pass and generating station. There are also subsidiary aqueducts and a road diversion. The dam is situated at the outlet of Loch Eigheach and has been built on solid granite, the length being 350 ft. and the maximum height 45 ft. As a result, the length of Loch Eigheach has been increased to about 1¾ miles, thus forming a reservoir with an effective storage of 170 million cub. ft. This reservoir is connected to a power station (which has been built on the borders of the ancient lands of the Clan Menzies, near the Black Wood of Rannoch) by a 12 ft. 6 in. diameter concrete-lined tunnel and reinforced-concrete penstock with a total length of 1,200 ft. A tunnel 1,060 ft. long and an aqueduct, 3,300 ft. long, have also been built to divert the waters of the Abhuinn Duibhe and the Allt Chaldar, respectively, into Loch Eigheach. The power station is at Gaur, where there is also a 1,400-ft. fish ladder comprising no less than 71 pools. The station contains one 6-MW Francis turbine, which is designed to operate under a gross head of 98 ft. and will, it is estimated, generate some 17 million kWh per annum. Its output will be fed into the line from Rannoch to Oban. On leaving this station the water will pass through the existing stations at Tummel Bridge, Clunie and Pitlochry before reaching the sea. The consulting engineers for the civil engineering works were Messrs. Babtie, Shaw and Morton, and for the plant and machinery, Messrs. Strain and Robertson, both of Glasgow. The civil engineering works were carried out by A. A. Stuart and Son (Glasgow), Limited, and the main control gates and valve were built by Glenfield and Kennedy, Limited, Kilmarnock. The machinery was constructed by Harland and Wolff, Limited, Scotstoun, for the English Electric Company, Limited. One of the Boards more extensive schemes has also been confirmed by the Secretary of State for Scotland. It covers a catchment area of over 250 square miles and is intended to develop the water-power resources of Loch Shin, its tributary streams, the River Cassley and the upper part of the River Brora. Loch Shin will be raised and enlarged by building a dam incorporating a generating station across the narrows just north of Lairg. A second dam will be built across the River Shin, below the present outlet of the loch, and water from the reservoir thus formed will be taken through an aqueduct to the main generating station near Inveran Hotel. Water from the upper River Brora will be diverted into the Shin catchment area by a weir at Dalnessie, and thence through an aqueduct into the River Tirry. A third generating station will be built near Creanich at the western end of Loch Shin and will use water diverted from the upper River Cassley and its tributaries. Feur Loch will be enlarged by a dam and its waters led by an aqueduct to a station on the southern shore of Loch Merkland, near Garvault. A final reservoir will be formed by building a dam to join three small locks, and water will be taken thence to a generating station on the north shore of Loch Merkland, east of the Stable Burn. The total installed capacity of the scheme will be 40 MW, and the estimated annual output 151 million kWh.

BUILDING RESEARCH AND DEVELOPMENT.

The Advisory Council on Building Research and Development have recently issued their second report (H.M. Stationery Office, price 1*s.* 3*d.*). The Council were appointed by the Minister of Works on December 8, 1947, and include representatives of building and civil engineering employers and operatives, and of the professions associated with building, but since the issue of the first report, in April, 1949, the terms of reference have been amended, the current terms now being, firstly, to keep under review the whole field of building research and technical development and the results obtained therefrom; secondly, to suggest from time to time subjects of further research and development (with due regard to their relative importance and urgency); and, lastly to advise on the methods of securing the use by industry of the results of research and technical development. The Building Research Station of the Department of Scientific and Industrial Research is the principal centre of building research in this country, although some research relevant to building is also carried out by other branches of the Department, such as the Forest Products Research Laboratory, the Road Research Laboratory, and the Joint Fire Research Organisation; some research is also carried out by the universities, research and development associations, and independent firms. The cost of research, therefore, is not accurately known, and it is accordingly estimated in the report that, during one financial year, some 700,000*l.* net of public funds is spent on research, and on publicity for the findings of research, directly undertaken for the benefit of the building industry and allied branches of civil engineering. This estimate does not contain any allowance for grants from public funds to universities for their work as a whole, which includes some building research. According to the report, the Council have concluded that considerable advantages were being derived from the study of plumbing and drainage systems; this research should reveal to what extent cheaper and less elaborate systems are compatible with efficiency. Importance is also attached to the study of thermal-insulation and house-heating systems which are likely to improve efficiency in the use of fuel, and the Council approve of the priority being given to the study of the deterioration of domestic chimneys, and to the comparison of the merits of various non-traditional methods of building houses. The Council also approve the priority being given to research on the vibration of concrete, and consider that the co-ordination of work in this field is important. The hope is expressed that the cement industry will regard a reduction in cement variation as a desirable goal, and will direct research and effort to its speedy attainment. In their first report, the Council recommended that the Ministry of Works should prepare and issue illustrated leaflets, largely directed to small builders, clerks of works and foremen. As a result, 27 such leaflets had appeared up to September, 1952, and the sales are now reputed to be most gratifying, with each leaflet averaging over 40,000 copies, and a total sale of over one million.

INCREASED AID FOR RURAL ELECTRIFICATION.

It may not have been altogether fortuitous that the insistence on the need to speed up rural electrification, which was one of the features of the recent British Electrical Power Conference at Torquay, should have been followed on Friday, June 19, by a debate on the same subject in the House of Commons. In urging that steps should be taken to develop the supply of electricity in rural areas as much and as fast as possible, Mr. A. R. Hurd repeated the figures given by Mr. Steward in the paper of which an account appears on page 829 of this issue, and pointed out that at the present rate of progress it would take another 20 years to provide all farms with electricity. He therefore recommended the removal of existing restrictions, a course in which he was supported by most of the other speakers in the debate. The Minister of Fuel and Power (Mr. Geoffrey Lloyd), in reply, agreed that the electricity supply industry had been hampered by capital restrictions, but in 1952 the allocation for rural electrification had been increased by 1*l.* million, while this year the limit was 6*l.* million and for next year a sum of 6·5*l.* million had been provisionally arranged. These figures represented the totals asked for by the Area Boards and had not been cut either by the British Electricity Authority or the Government. He agreed that the Area Boards had lived for so long in an atmosphere of rigid capital limitation that they needed encouragement. The Government had therefore decided to make a further increase of 1·5*l.* million over the next 18 months in the capital approved for rural electrification. This would bring the figure for next year up to 7·5*l.* million, compared with the 3*l.* million inherited by the pre-

sent Government. In addition, it had been decided to remove the ban on promotional advertising imposed when power cuts were general. Such advertising was an essential factor in rural electrification, in order to bring about the easement which would result from increasing the number of consumers.

LETTERS TO THE EDITOR.

CREEP PROPERTIES OF STEELS FOR POWER PLANTS.

TO THE EDITOR OF ENGINEERING.

SIR,—We thank Mr. J. H. M. Draper and Mr. G. Gosling for the interest they have shown in our article on the above subject. We are, however, unable to accept the opinion expressed at the conclusion of their remarks in the letter on page 755 of your issue of June 12. The reasons for this are given in the following paragraphs.

The basis of the criticism of Draper and Gosling is that we have used a constant value of n for the three materials, instead of one variable, over the extreme load range of 4 to 6 tons per square inch. The values of n used by us are given in Table VII on page 60 of ENGINEERING for January 9; for convenience they are reproduced here.

Material.	n, Value suggested by Dr. Bailey.	n, Value obtained by N.P.L.
0·17 per cent. carbon steel ..	6	7·3
0·5 per cent. molybdenum steel ..	3	—
0·5 per cent. molybdenum, 0·23 per cent. vanadium steel ..	6	5·6

The values under the heading "suggested by Dr. Bailey" were actually taken from a Metropolitan-Vickers' report on the "Allowance for Temperature and Pressure Peaks in the operation of High Temperature Steam Power Plant," of February, 1949, and were therein stated without comment to be appropriate values for the conditions concerned in the research. However, in the cases of the 0·17 per cent. carbon steel and the 0·5 per cent. molybdenum, 0·23 per cent. vanadium steel, these values were merely quoted on account of their moderate proximity to our experimental values, while in the case of the 0·5 per cent. molybdenum steel no experimental data were available and the Metropolitan-Vickers' value was quoted in the absence of any other evidence to fill the gap.

The point the authors wish to make, however, is that values obtained directly from the actual material used are available only for the 0·17 per cent. C steel and the molybdenum-vanadium steel; all other values, either those under the heading "suggested by Dr. Bailey" or mentioned by Draper and Gosling in their letter, are simply values of a similar class of material and have only comparative value.

Now, examining the values obtained directly from the actual material, we refer to Figs. 1 to 3, herewith, two of which show plots of log stress/log time for a series of constant strains for 0·17 per cent. C steel at 977 and 1,067 deg. F., and the third, a similar plot for 0·5 per cent. Mo 0·23 per cent. Va steel at 1,193 deg. F. In these figures it is demonstrated beyond doubt that, over the stress range concerned, the slope of the log stress/log time lines for several specific strains is closely constant, and that n has therefore constant values which are those given in the table quoted above. Accordingly, the contention of Draper and Gosling that the authors are incorrect in taking a constant value for n in relation to the 50 per cent. and other pressure peaks cannot be accepted, and the values of equivalent temperature deviations worked out by the authors in regard to the 0·17 per cent. C and the 0·5 per cent. Mo, 0·23 per cent. Va steel must stand, as must also the conclusion based upon them. The case of the 0·5 per cent. Mo steel, in the absence of experimental data regarding n direct from the material, must be regarded as not proven.

In regard to the period of incidence of 50 per cent. peak stresses, during the course of the work Dr. Bailey suggested to the authors that a 5 per cent. period of incidence should be used in their work.

CREEP PROPERTIES OF STEELS.

Fig. 1. RELATION BETWEEN LOG STRESS AND LOG TIME AT SPECIFIC VALUES OF CREEP STRAIN FOR 0·17 PER CENT. C. STEEL AT 977 DEG. F.

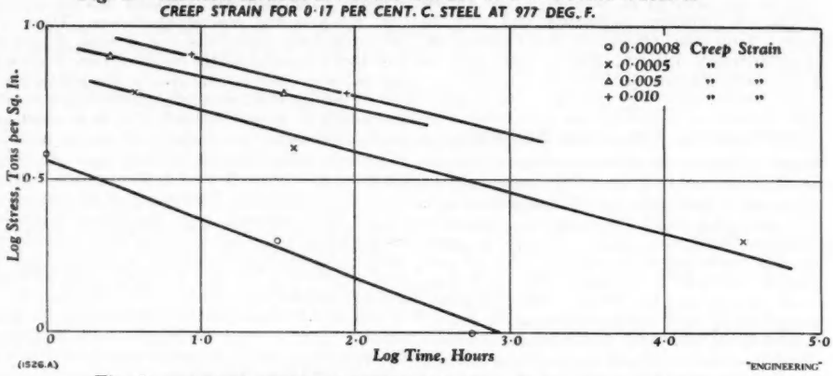


Fig. 2. RELATION BETWEEN LOG STRESS AND LOG TIME AT SPECIFIC VALUES OF CREEP STRAIN FOR 0·17 PER CENT. C. STEEL AT 1,067 DEG. F.

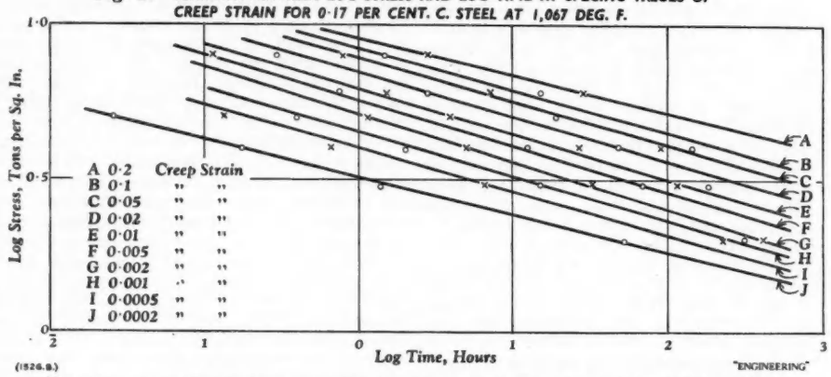
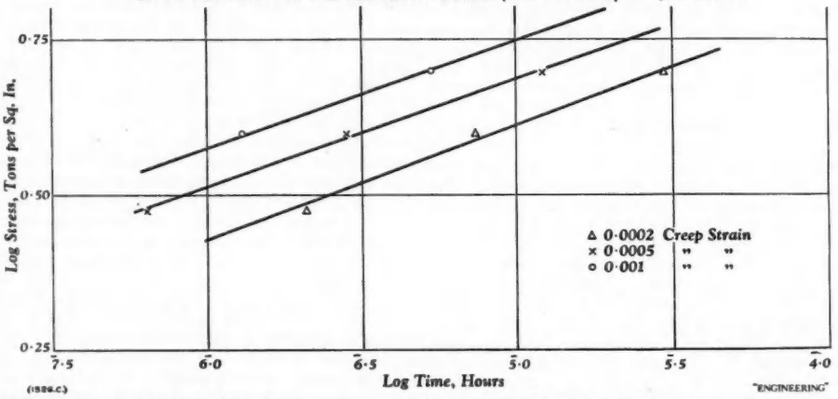


Fig. 3. RELATION BETWEEN LOG STRESS AND LOG TIME AT SPECIFIC VALUES OF CREEP STRAIN FOR 0·5 PER CENT. Mo 0·23 PER CENT. Va STEEL (PIPE MATERIAL) AT 1,193 DEG. F.



However, we understand that he now does not regard this as representing the practical case, and states that a very much smaller period of 0·15 per cent. is probably correct. If this is so, it is apparent that the whole question of these 50 per cent. stress peaks becomes virtually academic only.

Yours faithfully,

A. E. JOHNSON.
N. E. FROST.

Mechanical Engineering Research Laboratory,
East Kilbride,
Glasgow.
June 13, 1953.

COMPENSATION FOR PERSONAL INJURIES.

TO THE EDITOR OF ENGINEERING.

SIR,—I should be glad if you would allow me to reply to Sir William Valentine Ball's letter to you, published in ENGINEERING of June 19, on page 787, with reference to my recent article on the above subject. Whilst I cannot do other than agree in principle with what Sir William has said in that letter, I feel that a little more is required to keep things in perspective.

Trial by jury in civil cases virtually ceased during the war years, because it was practically impossible to assemble a jury at that time. Since the return of more normal conditions, juries are again available; but, even in cases where they may be demanded as of right, they are rarely called for. This may be due to the legal profession having got out of the habit of thinking in terms of juries, for there are many counsel now practising who have little or no experience of them. Cost of trial is probably another factor, trial by jury inevitably taking longer than trial without. Whether a particular personal injuries case is to be tried by jury is a matter of the discretion of the court; it cannot be demanded. In practice, this discretion is exercised by the Master (an office filled with great distinction, for many years, by Sir William), who will not, as a rule, allow a jury if considerable scientific or medical evidence has to be taken. In some respects a jury may prove disadvantageous to a plaintiff. If the issues of fact are complicated, even the best summing up by the judge may fail to impress the jury; if the issue is one of law, the jury is not concerned,

save as to the amount of damages. In either event, it is unlikely that they would be able to assess the damages as correctly as would a judge alone.

Finally, it is of interest to note that, in the list of actions for hearing in the Queen's Bench Division of the High Court during the present Sittings, there are a mere eleven cases with juries, and four of these involve personal injuries claims. But there are some 570 cases of all kinds for hearing without juries, and of these nearly 300 are concerned with personal injuries. Surely these figures speak for themselves.

Yours faithfully,
C. F. MAYSON.

Temple,
London, E.C.4.
June 22, 1953.

PHYSICAL PROPERTIES OF STEEL AS FUNCTIONS OF THE TEMPERING TEMPERATURE.

TO THE EDITOR OF ENGINEERING.

SIR,—With reference to the article on tempering and the physical properties of steel, by Mr. A. A. Peebles, on page 613 of your issue of May 15, it seems desirable that some warning should be given lest readers might be tempted to generalise from the equations given.

These equations are based upon experiments carried out on a single sample of steel, tempered at various temperatures, and can apply only to this particular sample, unless it can be shown by further experiments that they have more general validity. Moreover, the mathematical processes imply that there may be real physical relationships between the various mechanical properties dealt with, as for example, the proportional limit and the Izod number. This is not necessarily the case.

The process described in the paper consists, briefly, in plotting each of the properties against tempering temperature, fitting mathematical equations to the resulting graphs, and finally eliminating the tempering temperatures from these equations to show the relationships between the properties. The fallacy of this procedure may be illustrated by the following example. A man's weight and his annual income may be plotted against his age to yield two equations, from which age may be eliminated to show a relationship between income and weight. Such a relationship exists fortuitously, if at all, for the particular individual studied, but unless he happens to be engaged in a business or occupation in which his weight influences his income (or vice-versa), e.g., a jockey or a prize-fighter, there is no actual physical relationship between the two quantities, even though shown by the mathematical process adopted. Moreover, the relationships derived in this way may be of an entirely different type for different individuals.

Some caution is also required with regard to some of the individual properties considered in the article. For example, the proportional limit, which incidentally is not defined in the article, is a more or less arbitrary concept, depending largely on the accuracy of the measurements and on the form of the test-piece. In some steels, the character of the load-extension diagram is radically altered by tempering. For example, a steel may show a yield-point after tempering at one temperature, but none after another, and after some tempering treatments the proportional limit may to all intents and purposes disappear. The Izod number is also to some extent arbitrary, and is usually understood to mean the energy absorption in a standard Izod test performed at room temperature. It is well known that in this test the energy absorption is highly sensitive to the temperature of testing, and that the sensitivity itself depends upon temperature and upon many characteristics of the steel, apart from its chemical composition, such as grain size and metallurgical structure. It is therefore an unjustified simplification to attempt to show a relationship between, say, proportional limit and Izod number, and to regard such a relationship as a property of the steel.

In connection with the Izod tests, it is important to note that the article states that only one specimen was broken for each tempering temperature. This disregards the large inherent scatter in this test, particularly in the middle ranges, around 30 ft.-lb.

Yours faithfully,
G. M. BOYD.

London,
June 16, 1953.

CONVERSAZIONE OF THE INSTITUTION OF CIVIL ENGINEERS.

THE models and apparatus which were assembled in the library of the Institution of Civil Engineers on the occasion of the annual conversazione (held on Thursday, June 18) included some which demonstrated the principles of new techniques of measurement and construction. Such were, for example, a range of various types of load gauges, a suspended fender, apparatus used in connection with the measurement of *p*H values, some miniature water-current velocity meters, an optical method of aligning long rails (but possibly applicable to other similar problems), and wind-tunnel equipments for studying the effect of ground formation and nearby buildings on smoke plumes from chimneys and for determining the most efficient design of snow fences. Among the exhibits of more general civil engineering interest, there were models of a coal mine, of a Coronation arch (as erected in the Mall), of an aluminium hangar, an aircraft servicing dock, etc.

The precision apparatus for aligning and levelling long rails was developed in connection with a ship-model testing tank which is to be built for the Department of Scientific and Industrial Research by the Ministry of Works. The heads of the rails are accurately machined and finished on the upper surface and the sides. They are required to be mounted level and aligned to close tolerances. The level is checked at a series of points along the upper surface by means of a Watts micrometer water level, and the alignment by means of a stretched wire and a travelling microscope. The wire is stretched parallel to one side of the rail head, the distance between the wire and the head being fixed by a distance piece at each end. The microscope is free to travel along the head of the rail, with its object lens above the wire. With the microscope in any desired position along the rail, the accuracy of alignment of that part of the rail is checked by observing the wire through the microscope and noting its position in relation to the graticules in the microscope (or, more precisely, noting the position of the graticules in relation to the wire, since the wire is truly straight and parallel to a line joining the ends of the rail, and it is the rail which is out of truth).

Rails accurately aligned and levelled by this means are mounted on the walls of the ship-model tank. The model under test is towed by a carriage (incorporating a dynamometer), which runs on the rails. The rails must be mounted truly as an error of even a few thousandths of an inch in alignment or level can have serious effects on the results of the tests. The joints between rails are made by Thermit welding. The apparatus for aligning, etc., was exhibited by Mr. P. T. Fletcher, B.Sc. (Eng.), M.I.C.E., chief engineer of the Ministry of Works.

The selection of load gauges, for use in the field and the laboratory, was exhibited by the Building Research Station (Dr. F. M. Lea, F.I.C., director). They served to show some of the advances that have been made in recent years in the design of load gauges which will continue to give reliable results in spite of infrequent calibration and difficult service conditions. The types exhibited ranged from a simple plate-indentation load gauge to the portable steel proving ring capable of measuring loads with extreme accuracy. They were classified into three main groups: electrical, mechanical and hydraulic. Electrical gauges can generally be used in remote places, and once they have been fixed in position the loads can be recorded at a distance. The vibrating-wire load gauge in particular appears to be specially suitable for field work, being compact, readily waterproofed, and remaining stable when kept under load for many months. The mechanical gauges included many rather heavy types with which it is usually necessary to approach the place where the gauge is fixed before a reading can be taken. The third group included the commonly known hydraulic pressure gauges in which the same fluid serves both the loading and recording systems, and also those pressure cells in which the recording fluid is separate from that of the loading system.

The miniature water-current meters, together with a wave-height analyser, were exhibited by the Hydraulics Research Station (director, Sir Claude Inglis, C.I.E., M.A.I., M.I.C.E., F.R.S.). Each current meter consists of a small multi-bladed propeller, submerged in the fluid the velocity of which is to be measured; two electrodes are placed in the fluid so that the blades pass between them, one after the other, as the propeller rotates. The change in conductance due to the passage of each blade between the electrodes is used to produce an electric pulse, and the rate of the series of such pulses is timed to determine the velocity of the fluid.

Three current-meter propellers were exhibited, each having helical blades accurately machined from polystyrene rod, and the propeller mounted between 0·15-mm. diameter conical bearings. Two propellers have a swept diameter of 24 mm., and differ only in the number of blades (5 and 10) and the method of mounting: one is in a Perspex cylinder and the other is in a stainless-steel bracket. The third propeller has five blades with a swept diameter of 9·5 mm. and is mounted in a Perspex cylinder. The two submerged electrodes of each meter form one arm of a bridge curcuit which is fed with 12-volt current at a frequency of 10 kilocycles per second. The change in conductance as each blade passes between the electrodes produces across the bridge circuit a modulated wave which is amplified. Two methods of timing the pulses were exhibited: the first consisted of counting and timing, using Dekatron circuits, and the second employed an electronic tachometer circuit. The miniature current meters are being developed for measuring water velocities in models of harbours and river estuaries.

The Hydraulic Research Station's wave-height analyser measures and records the height of each of a train of 300 waves. A series of thin rods are suspended vertically in the tank, each to a different depth so as to be able to measure a range of wave heights. Thirty-two Post Office telephone call meters are provided, each corresponding to a particular wave height. Each wave produces a group of voltage pulses, the number being proportional to wave height. The pulses operate a counter which selects the appropriate P.O. meter, a count of one being recorded on this meter as the water level falls. The instrument stops automatically after 300 waves have been recorded, and from the results the "significant wave-height" and the height distribution can be determined. The height measured is that from a trough to the following crest; slow changes of mean water level do not affect the results.

Vessels for simplifying the technique of determining *p*H values were shown by Dr. S. Lewin, of the South-West Essex Technical College. The solution to be measured is maintained at a constant temperature and is electrically screened by surrounding the vessel containing it by a jacket in which there is thermostatically-controlled and earthed water. This method is said to have advantages over conventional methods. Placing the vessel containing the solution in a thermostat unit, taking measurements and then removing it is a cumbersome procedure when many tests have to be made. It is possible to place the containing vessel in a specially-built thermostat which allows the vessel to protrude, and to have an outlet with a tap at the bottom so that many measurements can be carried out easily; but this method is regarded as expensive. Dr. Lewin's apparatus also makes use of a lower tap outlet. The inner vessel is so designed that it requires only a small quantity of solution—3 c.c. or 0·7 c.c.—and between it and the outer jacket water drawn from a thermostat unit is circulated. The apparatus has the further advantage that the earthing of the circulating water, by

using short lengths of metal tubing as part of the leads, results in thorough electrical screening of the complete cell assembly. It has been found to give excellent stability and reproducibility of recorded *p*H values.

The suspended fender is a British invention, the various forms of which are protected by patents. A model of a new three-point suspension fender—a type which has not yet been used—was shown by Professor A. L. L. Baker, B.Sc., M.I.C.E. Suspended (or gravity) fenders have been used since 1944 as shock absorbers or buffers to reduce the impact on jetties from ships berthing under exposed conditions. The Mulberry Harbour pier heads had reinforced-concrete fenders of this type so that tank-carrying craft could berth rapidly and without damage. Fenders weighing 45 tons were incorporated in the design of the Kuwait oil jetty, enabling oil tankers to berth without delays in the open sea. The new three-point suspension has the advantage of not requiring low-water supports; in addition, it presents only a small surface to wave "slap"—unlike some types of suspended fender which have been tried.

From the Aerodynamics Division of the National Physical Laboratory (director, Dr. E. C. Bullard, Sc.D., F.R.S.) there was a landscape model which is used in a wind tunnel for determining the best height for factory or power-station chimneys. There were also photographs of models of factories and chimneys, with smoke issuing from the latter; these showed how a building on the windward side of a chimney causes the smoke plume to be deflected down towards the ground, whereas a building on the leeward side encourages the smoke to rise. The model of the local landscape is used in experiments for determining the extent of the pollution from a factory chimney. The model is built in a wood to a scale of 4 ft. to a mile, and comprises an 8-ft. diameter centre section, surrounded by a ring 2 ft. wide. The centre section is rotated on a turntable in the wind tunnel, and the upwind and downwind portions of the ring are fitted to give an overall model length of 12 ft. Steam, or smoke generated from paraffin, is discharged from the model chimney and the plume is photographed. From the photographs the centre-line of the plume may be traced, and the required information on the probable pollution at a given distance from the chimney can be calculated. A common design rule is that the chimney height should be about 2½ times the building height, but it should be remembered that "building height" refers to the highest building in the vicinity of the factory site. The N.P.L. also exhibited a shielded hot-wire anemometer of the type used to explore draught levels over ship decks and superstructures. It is particularly sensitive at low wind speeds and, provided the wire is placed normal to the wind, it is largely insensitive to wind direction.

The wind tunnel is also being used for producing mimic blizzards, so that a study can be made of the action of snow fences in checking the drifting of snow on roads and railways. The Road Research Laboratory (director, Dr. W. H. Glanville, C.B., C.B.E., M.I.C.E.) showed a small wind tunnel set up for this purpose. Tests have shown that the greatest volume of drifting snow is collected around an open fence in which the slats are separated from each other by a distance slightly greater than their own width. To combat the worst conditions in various parts of Great Britain, fences should be from 4 ft. to 6 ft. high. In a snow blizzard the bulk of the snow is carried across open country within a few inches of the ground; snow fences are placed some 20 to 30 yards to windward of the road or railway to be protected. They check the velocity of the wind by causing eddies, thus making the snow settle near the fence, away from the road or railway.

A third—and topical—application of the wind tunnel was in connection with tests on an experimental model of one of the Coronation arches—tubular structures erected in the Mall on the approach to Buckingham Palace. The model was tested at the N.P.L. so that wind forces on an actual arch could be checked. In the tunnel the model was suspended from a brass plate at the crown, with the four feet of the arch free. Forces and moments due to wind at varying inclinations, in both the horizontal and vertical planes, were carefully measured. With a wind velocity of 60 miles an hour the maximum horizontal force was found to be equivalent to 2·5 tons on the actual arch. The model was exhibited by Mr. G. C. Greetham, chief structural engineer of the Ministry of Works. The arches were designed by Mr. R. B. Unwin, A.M.I.C.E., senior structural engineer, Ministry of Works, to the requirements of Mr. Eric Bedford, chief architect, and they were made and erected by Scaffolding (Great Britain), Limited.

The principle of the arch—in this case the true or catenary arch—was also the subject of an exhibit provided by Mr. J. H. de W. Waller, D.S.O., O.B.E., M.E., M.Sc., M.I.C.E. He showed models and photographs of buildings, admirably simple, of which the cross-section is a true arch and the longitudinal section is a series of corrugations which effectively resist secondary stresses due to wind, temperature variations, etc. The initial temporary frame of the building consists of a series of arched ribs, regularly pitched along the length of the proposed building. The ribs are then sheeted over with light hessian, and concrete and reinforcement are applied. The wet concrete causes the hessian to sag, thus producing the desired corrugations. Over a million square feet of floor area have been covered by this system.

Mr. R. U. Law, M.I.C.E. (managing director, George Wimpey and Company, Limited), exhibited a well-point of novel design; photographs of a new type of lifting tongs, capable of handling 15-ton blocks of rock; and a model of a multi-storey block of flats in which in-filling panels of no-fines concrete are used in conjunction with a reinforced-concrete frame. The external surface of the flats block is rendered, and the whole construction is weatherproof; thermal insulation of the no-fines wall is equivalent to that of an 11-in. cavity brick wall. The Wimpey well-point consists of a larger number of special washers placed together so as to form a laminated cylindrical unit. The washers are in place of the usual gauze, which has a tendency to split. Maintenance costs of the Wimpey well-point are low.

Dr. H. Q. Golder, A.M.I.C.E., exhibited a model of a deep-well ground-water lowering system, a single-well de-watering a cofferdam, and a section of a previous dam showing the effect of an impervious apron and cut-off. The main part of the model showed a quarter-section of an excavation in water-bearing sand, dewatered by a system of deep wells. The lowered water levels could be traced through the ground in observation wells, and the pattern of flow could be followed by the injection of dye. The pumping could be stopped to show the effect of flooding the excavation. The single deep well adjacent to a cofferdam was in pervious ground under a high water pressure, in which normal excavation would be impossible owing to base heave; the ground was rendered quite stable by draining from the well.

A grouting point used for injecting cement grout, under pressure, into soft fissured clay railway embankments, at depths of about 12 to 17 ft. below the top of the sleeper, was shown by Mr. M. G. R. Smith, M.B.E., M.Sc., M.I.C.E., civil engineer, British Railways (Western Region). Difficulty had been experienced in preventing the grout from working its way upwards round the inside of the tube used for injecting it into the embankment. A special grouting point was therefore developed. While it is being driven, the slots through which the grout later emerges are covered, thus avoiding clogging; when the grouting point has reached the required depth, a bar is introduced within the tube of the grouting point, and the forward part is driven further into the soil, thereby uncovering the slots. The embankment work on which this equipment was used was described in ENGINEERING, on pages 456 and 487 of the issues of April 10 and 17, 1953.

A model of a maintenance "dock" for Elizabethan class aircraft of British European Airways was exhibited by Mr. D. W. Setterington, B.Sc., A.M.I.C.E. This dock has been designed by Messrs. Wilson and Rodger, and has been built by the Heston Aircraft Company, Limited; it will shortly be in use in one of the new B.E.A. hangars at London Airport. Besides providing rigid working platforms at strategic levels around the aircraft, it is fitted with tools and appliances for use during aircraft servicing, and it is supplied with compressed air, grease, electricity, water and other fluids.

Another aircraft subject was the model of an aluminium-alloy hangar shown by Mr. Deane Devereux (director, Structural and Mechanical Development Engineers, Limited). Hangars of this kind are being supplied to the de Havilland Aircraft Company to house Comet jet airliners. The building has a clear span of 200 ft., believed to be the largest span in aluminium alloy in the world. In a span of this width, the structural weight is only about a seventh of that of an equivalent steel structure. Thus, apart from the saving in material, the light weight permits prefabrication and transport of very large sub-assemblies, and their erection with a minimum of labour and equipment. The structure, which does not require painting, was described on page 97 of our issue of January 23, 1953.

The other exhibits were a model of a modern coal-mine (Mr. A. Young, M.I.C.E., chief civil engineer, National Coal Board); a model illustrating three phases in the work of repositioning the King Henry VIII Crypt at the site of the new Government offices, Whitehall-gardens (Mr. L. Scott White, O.B.E., M.I.C.E.); three drawings signed by Thomas Wicksteed, circa 1848, the engineer who introduced the Cornish beam engine to London (Mr. H. F. Cronin, C.B.E., M.C., B.Sc., M.I.C.E., chief engineer, Metropolitan Water Board, and President of the Institution of Civil Engineers); models of the Grindan tunnel which forms part of the proposed motor-way designed to by-pass the town centre of Newport, Monmouthshire, and of an open spandril arch bridge which is to cross the River Lune near Sedbergh on the proposed Lune Valley motor-way, providing an alternative to the existing trunk road over Shap (Mr. E. B. Hugh-Jones, M.C., B.Sc., chief engineer, Ministry of Works); a model to illustrate the raising of a part of the Mullardoch Dam on the Affric hydro-electric scheme in Scotland (Mr. C. M. Roberts, M.I.C.E.); two dioramas, giving general impressions of the Port of Beira and the Claerwen Dam (Sir William Halcrow, M.I.C.E.); a diorama giving a general impression of the Greenwell dry dock at Sunderland (Mr. Peter Scott, B.Sc., M.I.C.E.); and a model of a sand-washing plant for filter beds (Mr. H. F. Cronin).

An exhibit provided by the Institution was a Tompion clock, the history of which is linked with that of this journal. In or about 1670, Charles II presented a bracket clock, the work of Thomas Tompion (1638-1713), to Barbara Villiers, Lady Castlemaine (later the Duchess of Grafton). This clock descended through the Grafton family, and in the early Nineteenth Century the fifth Duke instructed the celebrated Court clockmaker, Benjamin Lewis Vulliamy (1780-1854), to repair it. Vulliamy found the movement in such a bad state that he replaced it by one of his own, and in 1847 he presented the defective movement to the Institution of Civil Engineers. It remained in this condition until 1913, when Dr. W. H. Maw (Editor of ENGINEERING from its foundation in 1866 until his death in 1924, and President of the Institution 1922-1923) placed it in the hands of Mr. E. T. Cottingham, who repaired it. A skeleton dial, with hands, was provided and the whole was placed in a glass case so that all parts are visible. It was not until 1937 that Sir John Prestige identified the movement as that belonging to the case still in the possession of the Duke of Grafton.

THE LATE MR. W. MEEK.—We regret to record the death of Mr. William Meek, B.Sc.(Lond.), A.R.S.M., which occurred suddenly at Llanvaches, Magor, Monmouthshire, on June 2. Mr. Meek, who was 54 years of age, was the chief mechanical engineer at the Royal Naval Propellant Factory, at Caerwent, Chepstow, Monmouthshire. He received his technical education at the Royal School of Mines, London, which he attended from 1916 to 1917 and, after war service, from 1919 to 1922, when he graduated with honours in metallurgy.

500-TON HYDRAULIC PRESS.

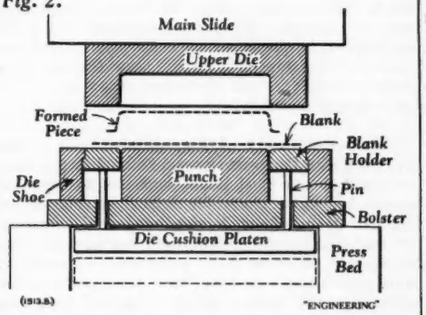
FIG. 1.

500-TON HYDRAULIC PRESS.

A 500-TON press for the deep drawing of sheet metal, built under licence from the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, U.S.A., has been installed recently at the Frigidaire Division of General Motors Limited, Stag-lane, London, N.W.9. The machine is shown in Fig. 1. It is one of a range of H.P.M. presses now being constructed in the United Kingdom by Messrs. John Shaw and Sons (Salford), Limited, Salford, 3, Lancashire. The sole agents are Messrs. A. C. Wickman, Limited, Tile Hill, Coventry. Known as the H.P.M. Fastraverse die-cushion press, it embodies two separate hydraulic systems, for operating the female half die, which is mounted on the main slide, and the blankholder ring, which is supported by a series of steel pins on a die-cushion platen in the press bed (Fig. 2). The stationary male punch is mounted on the press bolster plate that covers the cavity in the press bed, in which the die cushion is installed. The die cushion can also be used as a stripper. The main press slide is arranged for mechanical knock-outs, but bars and guides are not normally supplied. The press may be effectively operated on short strokes and, with the cushion idle, for single-action pressing such as embossing, straightening, etc.

The press frame consists of a head and a bed, joined by a pair of upright members. Two pre-tensioned tie-rods through each upright member lock the assembly together. The head incorporates a hydraulic cylinder and a ram which actuates the main slide, the latter being guided by bevelled ways on the four inner corners of the uprights, with gibs arranged to oppose any twisting of the slide.

Fig. 2.



The standard die-cushion pressure can be adjusted down to 20 per cent. of the maximum pressure value. By replacing the standard relief-valve springs with special springs, however, the minimum die-cushion pressure can be reduced to 6 per cent. of the maximum value. Double-unit relief valves can be employed to give still lower die-cushion pressures. Only one hydraulic pump is used; the downward movement of the main press slide intensifies the pressure of the oil trapped in the die-cushion cylinders and produces the resisting force necessary for holding the blank.

It is possible to instal two individual die cushions in a single press bed, the pressure of each being independently adjustable. A hydraulic counterbalancing mechanism offsets the effect of any variation of the die-cushion loads on the main slide, keeping it level. The double die cushion facilitates the use of a pair of progressive drawing dies, giving a first and second draw at each stroke.

FORTHCOMING EXHIBITIONS AND CONFERENCES.

THIS list appears in the last issue of each month. Organisers are invited to send to the Editor particulars of forthcoming events.

EXHIBITION OF HISTORIC BOOKS ON MACHINES.—Friday, May 1, to Sunday, August 30, at the Science Museum, South Kensington, London, S.W.7. (Telephone: KENsington 6371.) See also page 623, *ante*.

"LONDON ON WHEELS" EXHIBITION.—Wednesday, May 20, to Saturday, August 29. At the Shareholders' Meeting Room, Euston Station, London, N.W.1. Organised by the British Transport Commission, 55, Broadway, London, S.W.1. (Telephone: ABBey 5666.) See also page 691, *ante*.

"SHELL AND THE GAS TURBINE" EXHIBITION.—June 3 to Monday, August 31, in the public enclosure, Northolt Airport. Organised by the Shell Petroleum Co., Ltd., St. Helen's-court, Great St. Helen's, London, E.C.3. (Telephone: AVEnue 4321.)

SECOND BRITISH INSTRUMENT INDUSTRIES' EXHIBITION.—Tuesday, June 30, to Saturday, July 11, at Olympia, London, W.14. Apply to F. W. Bridges & Sons, Ltd., Grand Buildings, Trafalgar-square, London, W.C.2. (Telephone: WHItehall 0568.)

ROYAL AGRICULTURAL SHOW.—Tuesday, July 7, to Friday, July 10, at Stanley Park, Blackpool. Organised by the Royal Agricultural Society of England, 16, Bedford-square, London, W.C.1. (Telephone: MUSeum 5905.)

INDUSTRIAL CO-PARTNERSHIP ASSOCIATION, SUMMER CONFERENCE.—Friday, July 10, to Monday, July 13, at Somerville College, Oxford. Apply to the secretary of the Association, 36, Victoria-street, London, S.W.1. (Telephone: ABBey 3342.)

SUMMER SCHOOL AND CONFERENCE ON THE PLASTIC DEFORMATION OF METALS.—Monday, July 13, to Thursday, July 16, at Bristol. Applications to the Director, Department of Adult Education, The University, Bristol, 8. (Telephone: Bristol 25071.) See also page 678, *ante*.

GREAT YORKSHIRE AGRICULTURAL SHOW.—Tuesday, July 14, to Thursday, July 16, at Harrogate. Apply to the Yorkshire Agricultural Society, Cliftonfield, Shipton-road, York. (Telephone: York 3102.)

SUMMER SCHOOL ON THE SOLID STATE AND HETEROGENEOUS CATALYSIS.—Wednesday, July 15, to Wednesday, July 22, at The University, Bristol. Applications to be made to the Director of the Department of Adult Education, The University, Bristol 8. (Telephone: Bristol 25071.) See also page 194, *ante*.

SEVENTH INTERNATIONAL CONGRESS OF RADIOLOGY.—Sunday, July 19, to Saturday, July 25, at Copenhagen. Further particulars obtainable from the secretary-general, Professor Flemming Nørgaard, Kommune-hospitalet, Copenhagen, Denmark.

ROYAL WELSH SHOW.—Wednesday, July 22, to Saturday, July 25, at Cardiff. Arranged by the Royal Welsh Agricultural Society, Queen's-road, Aberystwyth. (Telephone: Aberystwyth 7551.)

SECOND INTERNATIONAL CONGRESS ON RHEOLOGY.—Sunday, July 26, to Friday, July 31, at St. Hilda's College, Oxford. Organised by the British Rheological Society, 140, Battersea Park-road, London, S.W.11, with the support of the Joint Commission on Rheology of the International Council of Scientific Unions. Applications to be made to Dr. G. W. Scott Blair, The University, Reading. (Telephone: Reading 4422.) See also page 250, *ante*.

THIRD INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING.—Sunday, August 16, to Tuesday, August 25, at Zürich and Lausanne. Apply to the secretary, Société Internationale de Mécanique des Sols et des Travaux de Fondations, Gloriastrasse 37, Zürich 44.

RADIO AND TELEVISION EXHIBITION.—Saturday, August 29, to Sunday, September 6, at Düsseldorf. *Agents:* John E. Buck and Co., 47, Brewer-street, London, W.1. (Telephone: GERrard 7576.)

NATIONAL RADIO SHOW.—Tuesday, September 1, to Saturday, September 12, at Earl's Court, London, S.W.5. Applications to the organisers, Radio Industries Council, 59, Russell-square, London, W.C.1. (Telephone: MUSeum 6901.)

BRITISH ASSOCIATION.—Wednesday, September 2, to Wednesday, September 9, at Liverpool. Applications to be made to the joint local secretaries: Mr. T. Alker, Municipal Buildings, Dale-street, Liverpool, 2. (Telephone: Central 8433); and Mr. S. Dumbell, O.B.E., University of Liverpool, Brownlow Hill, Liverpool, 3. (Telephone: Royal 6022.) See also page 214, *ante*.

BUILDING PLANT EXHIBITION.—Thursday, September 3, to Wednesday, September 9, on the Goole Fair site at Nottingham. Organised by the Ministry of Works, Lambeth Bridge House, Albert-embankment, London, S.E.1. (Telephone: RELiance 7611.)

19TH ENGINEERING, MARINE AND WELDING EXHIBITION AND CHEMICAL PLANT EXHIBITION.—Thursday, September 3, to Thursday, September 17, at Olympia, London, W.14. Apply to F. W. Bridges & Sons, Ltd., Grand Buildings, Trafalgar-square, London, W.C.2. (Telephone: WHItehall 0568.)

AMERICAN CHEMICAL SOCIETY: 124TH NATIONAL MEETING.—Sunday, September 6, to Friday, September 11, at Chicago, Illinois. Apply to the secretary, American Chemical Society, 1155, 16th-street, Washington 6, D.C., U.S.A.

FORESTRY AND THE TIMBER INDUSTRIES CONGRESS.—Monday, September 7, to Saturday, September 12, at Stuttgart, Germany. Held under the auspices of the Organisation for European Economic Co-operation and the Mutual Security Agency. Apply to the secretary of the congress, Mr. Eberhard von Bernuth, Luisenstrasse 33, Bonn, Germany. See also page 664, *ante*.

INSTITUTION OF NAVAL ARCHITECTS AUTUMN MEETING.—Monday, September 14, to Friday, September 18, at Scheveningen, Holland. Apply to the secretary of the Institution, 10, Upper Belgrave-street, Westminster, London, S.W.1. (Telephone: SLOane 4622.) See also page 703, *ante*.

FOURTH ANGLO-AMERICAN AERONAUTICAL CONFERENCE.—Monday, September 14, to Thursday, September 17, in London. Communications to the secretary, Royal Aeronautical Society, 4, Hamilton-place, London, W.1. (Telephone: GROsvenor 3515.) See also page 678.

PUBLIC LIGHTING CONFERENCE AND EXHIBITION.—Tuesday, September 15, to Friday, September 18, at Liverpool. Arranged by the Association of Public Lighting Engineers, 22, Surrey-street, London, W.C.2. (Telephone: TEMple Bar 9607.)

CONGRESS OF THE INTERNATIONAL SCIENTIFIC FILM ASSOCIATION.—Friday, September 18, to Sunday, September 27, at the Royal Festival Hall and the National Film Theatre, London, S.E.1. Organised by the Scientific Film Association, 164, Shaftesbury-avenue, London, W.C.2. (Telephone: TEMple Bar 4694.) See also page 706, *ante*.

EIGHTH NATIONAL INSTRUMENT EXHIBIT.—Monday, September 21, to Friday, September 25, at the Sherman Hotel, Chicago. Organised by the Instrument Society of America, 921, Ridge-avenue, Pittsburgh 12, Pennsylvania, U.S.A.

CONFERENCE ON INDUSTRIAL APPLICATIONS OF STATISTICS.—Friday, September 25, to Sunday, September 27, at the College of Aeronautics, Cranfield, Bedfordshire. Organised by the Royal Statistical Society, 4, Portugal-street, London, W.C.2. (Telephone: HOLborn 4283.) See also page 685, *ante*.

AMERICAN SOCIETY OF AUTOMOTIVE ENGINEERS: NATIONAL AERONAUTICAL MEETING, AIRCRAFT ENGINEERING DISPLAY AND AIRCRAFT PRODUCTION FORUM.—Wednesday, October 7, to Saturday, October 10, at Los Angeles, California. Apply to the secretary of the Society, 29, West 39th-street, New York 18, U.S.A.

FIFTH INTERNATIONAL MECHANICAL ENGINEERING CONGRESS.—Friday, October 9, to Thursday, October 15, at Turin. Organised by the Associazione Industriali Metallurgici Meccanici Affini, Via Massena 20, Turin. Applications to be sent to the director, British Engineers' Association, 32, Victoria-street, London, S.W.1. (Telephone: ABBey 2141.) See also page 250, *ante*.

ENGINEERING INDUSTRIES ASSOCIATION; LONDON REGIONAL DISPLAY.—Tuesday, Wednesday and Thursday, October 13, 14 and 15, at the Horticultural Hall, Vincent-square, London, S.W.1. Apply to the secretary of the Association, 9, Seymour-street, Portman-square, London, W.1. (Telephone: WELbeck 2241.)

INTERNATIONAL TEXTILE MACHINERY AND ACCESSORIES EXHIBITION.—Wednesday, October 14, to Saturday, October 24, at Belle Vue, Manchester. Organised by the Textile Recorder Machinery and Accessories Exhibitions, Ltd., Old Colony House, South King-street, Manchester, 2. (Telephone: Blackfriars 7234-6.)

INTERNATIONAL MOTOR SHOW.—Wednesday, October 21, to Saturday, October 31, at Earl's Court, London, S.W.5. Organised by the Society of Motor Manufacturers and Traders, Ltd., 148, Piccadilly, London, W.1. (Telephone: GROsvenor 4040.)

SCOTTISH MOTOR SHOW.—Friday, November 13, to Saturday, November 21, at Kelvin Hall, Glasgow. Apply to the Scottish Motor Trades Association, Ltd., 3, Palmerston-place, Edinburgh, 12. (Telephone: Central 3643.)

CYCLE AND MOTOR CYCLE SHOW.—Saturday, November 14, to Saturday, November 21, at Earl's Court, London, S.W.5. Organised by the British Cycle and Motor Cycle Manufacturers' and Traders' Union, The Towers, Warwick-road, Coventry. (Telephone: Coventry 62511.)

SMITHFIELD SHOW AND AGRICULTURAL MACHINERY EXHIBITION.—Monday, December 7, to Friday, December 11, at Earl's Court, London, S.W.5. Details obtainable from the Smithfield Show Joint Committee, 148, Piccadilly, London, W.1. (Telephone: GROsvenor 4040.)

LABOUR NOTES.

JOINT consultation and higher productivity in industry were two of the matters dealt with at some length by Sir Walter Monckton, Q.C., the Minister of Labour and National Service, in an address to the thirty-sixth annual session of the International Labour Conference at Geneva on June 18. He described higher productivity as "the means of obtaining more production, or better quality production, from the same resources," and said that it did not necessarily imply the expenditure of greater physical effort or an increase in the intensity of work. On the other hand, it did mean the employment of improved methods, clearer thinking and greater diligence, by all concerned, so that there was an advance in the effectiveness of a given amount of work expended upon the same quantity of resources.

Referring to observations by the director-general of the International Labour Organisation, in his report to the conference, Sir Walter commented that the director-general very wisely recognised the fears and reservations which occasionally arose in the minds of employers and workpeople alike when the word "productivity" was mentioned. The matter was of considerable importance. It was not simply a question of dispersing any fears and reservations which might exist in the minds of delegates to that conference: it was a question of finding some way of ensuring that these doubts were dispelled at floor level in the individual factory, mine, port or farm. It was fairly easy to convince an individual workman or employer that higher productivity was desirable for the good of a country's economy as a whole, but it was a far different matter when it came to trying to explain to a man why he might have to change his job or to an employer why he should re-organise his business. They were each entitled to an explanation, and it was the duty of those at the highest level to provide one.

The need was for the development of consultation and co-operation between workpeople and employers as an essential first step towards the application of measures to secure increased standards of production. Sir Walter stated that great importance was attached in Britain to the practice of joint consultation between the two sides of industry at all levels, and to regarding the employee as an intelligent and responsible individual, with his own separate contribution to make to the success of the business as a whole. The establishment of works committees was not enough. Traditional methods and practices should be preserved wherever possible, but the value of them depended largely upon their adaptability. This, in turn, depended upon good will and mutual confidence.

The appointment of leading members of the Trades Union Congress General Council to positions on the Iron and Steel Board continues to form one of the leading subjects for debate in trade-union circles. Mr. Andrew Naesmith, general secretary of the Amalgamated Weavers' Association, who accepted a part-time post on the Board, received a somewhat angry reception from some parts of the audience at the annual demonstration of Yorkshire miners at Doncaster on June 20. He told those assembled that the new Board, to which he and his trade-union colleagues had been appointed, would not be concerned with the denationalisation of the industry, but would be responsible for promoting its efficiency and economical working.

The trade-union members would represent the interests of the trade unions. It was to the definite advantage of the unions that their representatives should work with, and influence, outside bodies, the activities of which affected the well-being of trade-union members. Mr. Naesmith said that he and his colleagues had been charged with the duty of conducting iron and steel production under competitive conditions. In particular, the Board would have to watch the production capacity of the industry, the arrangements for procuring and distributing raw materials, the settling of prices, and the organising of research, technical training, and the education of the workpeople generally. Safety precautions, health and welfare arrangements, and joint-consultation measures would also come within the Board's sphere.

Speaking at Edgbaston, Birmingham, on Sunday, Mr. Stanley Evans, Labour M.P. for Wednesbury, said that the Labour movement's main source of strength still lay in its alliance with the trade unions, and that when trade-union leaders were traduced, the interests of both bodies suffered. He considered that it was nonsense to attack Sir Lincoln Evans, because he decided that he could best serve the nation and the men with whom he had been associated, by accepting a position on the Iron and Steel Board.

Support for the trade-union leaders was also given by Mr. Tom Williamson, the general secretary of the National Union of General and Municipal Workers, at the union's annual conference at Blackpool on June 17. He asked the delegates to consider the question of the gas industry. If the Government had decided to denationalise part of that industry, and had set up a public Board to control the private-enterprise section of the industry, would employees in gas undertakings suggest that trade-union leaders should refuse posts on that Board? Such posts would be there to protect the interests of the workpeople.

As is usual on such occasions, the delegates at the annual conference of the National Union of General and Municipal Workers had before them a large number of resolutions, covering a very wide field of economic and industrial activity. Many of these resolutions dealt with wages and working conditions, and were generally in line with those which have been discussed at other trade-union conferences during recent weeks. The delegates approved unanimously a resolution urging the Government to adopt measures to stabilise prices and place a check on "inflationary tendencies." These "tendencies," the delegates affirmed, were causing hardship to large sections of the population and threatening social security.

Criticisms that promotion in the Post Office was being blocked by the retention of men over the age of 60 at lower rates of pay were made at the annual conference of the Post Office Engineering Union at Bridlington, Yorkshire, last week. It was claimed that the Department first retained the services of these men and then, when they were at last permitted to retire, declared their positions redundant. A report from the union's executive council stated that the problem was mainly the concern of the younger and middle-aged members. It was considered that 60-year-old Post Office employees should have the opportunity to remain in the service if they wished in a supernumerary capacity. The delegates decided to refer this report back to the council for further consideration.

In his presidential address to the conference, Mr. L. G. Fox complained about the restrictions which prevented the Post Office from undertaking many items of capital expenditure. An immense waiting list of prospective customers existed at the same time that the Department's surplus trading balance was shrinking. It was an extraordinary policy for the Department to adopt. The lack of expansion had had disastrous effects on the promotion prospects of the union's members. There were few vacancies in the engineering section and the standard of entrance had been kept "almost unbelievably high."

The strike position at the Clydebank shipyard of Messrs. John Brown and Company, Limited, continued to deteriorate last week. The dispute arose on the question of whether boilermakers or shipwrights should undertake insulation work on the Arcadia. Consultations at the highest levels between the representatives of the unions concerned took place at Newcastle-upon-Tyne on Monday last, following an appeal to the Clyde district committee of the Confederation of Shipbuilding and Engineering Unions to end the stoppage.

GEAR SHAVING.

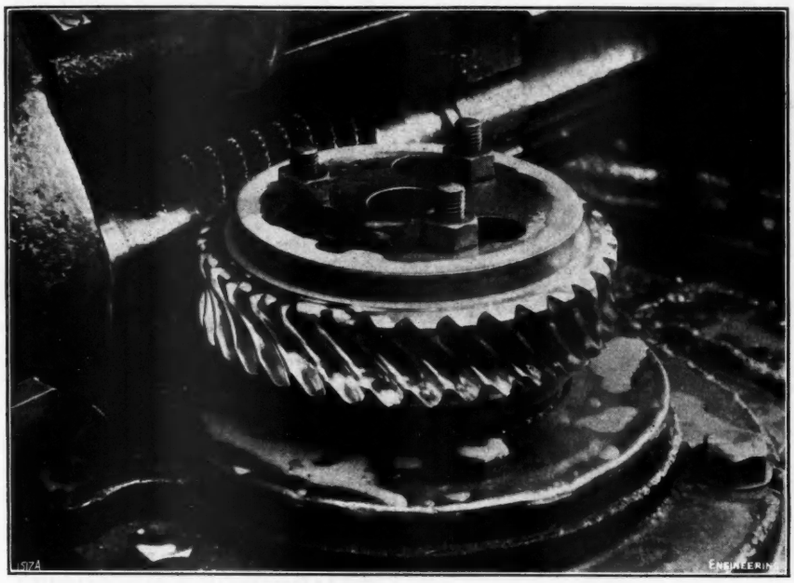


FIG. 1.

GEAR SHAVING.*

By W. A. SYKES.

THE finishing process for gear teeth known as gear shaving involves the reduction of surface irregularities by means of a tool which operates freely on excrescences, and affects neighbouring hollows to a lesser degree. The tool that is used has a large number of cutting edges, each backed by a narrow unrelieved land, and is made by cutting grooves or serrations in the flanks of a normal gear of hardened material. Gear shaving was originally introduced for the finishing of wormwheels by means of a reamer hob or serrated hob, as shown in Fig. 1, but has since been extended to cover the finishing of spur and helical gears. The type of shaving cutter in general use for spur and helical gears is identical in its description and method of construction with the serrated hob used for wormwheels; in fact, David Brown patents and practice in connection with the latter have been held to invalidate certain American patents covering shaving cutters. The action of the tool may be compared with that of a hand scraper, which, in itself, is not a free-cutting tool, but one requiring a certain amount of pressure towards the surface being treated, to make it cut. A truer comparison with a shaving cutter would be to consider a scraper in which the end is almost parallel with the surface of the work. Such a tool requires more pressure than does an ordinary hand scraper to make it operate. Gear shaving is an operation of controlled scraping by a machine instead of by hand.

A normal turning tool produces a chip, by virtue of its front clearance and rake. Now, considering a tool in which the front face almost fits the circumferential surface of the shaft, it will be realised that such a tool would produce only a very small chip, as the front face of the tool would resist penetration into the surface of the work. Nevertheless, this tool would remove small excrescences. Fig. 2 shows a shaving cutter in contact with a tooth profile, with a very small clearance angle between the lands on the cutter and the work; free cutting is not likely to take place where the curve is smooth, but again, wherever there are excrescences they would be removed readily. If a is at the highest point of contact and the cutting pressure has caused a penetration of 0·0001 in., there will be a fairly large area of contact on the tips of the lands which tends to resist further penetration. It is very noticeable in the operation of shaving that cutting takes place much more freely on the first few passes than after a large number of passes have been taken and the surface of the work has become smooth. The contact between a shaving cutter and the mating gear, with the axis crossed in the usual manner, is in the form of a relatively long and narrow ellipse. The centre of the ellipse, as shown in Fig. 2, would be at the point where the cutter just touches the work under slight load; and at other points on the cutter, remote from the centre of the ellipse, the depth of cutting will be smaller than at a. With a shaving cutter which has a helical tooth serrated in the normal manner, with the edges approximately parallel to the side faces, there is an acute angle at the edge a which gives a positive rake, while there is an obtuse angle at the edge b giving a negative rake. A question might be raised as to whether the positive-rake side cuts the more freely; no difference has been established up to the present.

A particular example of the way excrescences can be removed, and one of outstanding importance, is in connection with slight wave errors which always exist in helical gears; a similar effect takes place in the removal of small irregularities of tooth profile of almost any type. Taking a section through both the gear and the cutter in a plane tangential to the two pitch circles it will be realised that the contour of both the cutter and the gear are convex. If the convex face of the cutter is in contact with a concave part of the tooth corresponding to a hollow between two waves, as shown in Fig. 3, the two fit each other closely and there is a large resistance to penetration of the cutting edges, but when contact is made at the peak of a wave, the convexity of the tooth profile reduces the area of the contact and causes cutting to take place more freely, which is what occurs in practice on wide helical gears. It has been found that a gear having a wave error of an amplitude of 0·0003 in. will show an error of less than 0·0001 in. after shaving, even if the wavelength is greater than the width of the cutter. It was previously stated that the contact area between the two waves was in the shape of an elongated ellipse; the conditions applied to wave error are that at the hollow of the wave the ellipse is more elongated, while at the peak of the wave it is shortened.

Internal gears can also be produced by shaving, but this is not a generating process, because the contact between the internal gear and the cutter does not necessarily lie in a plane tangential to the base cylinder of the gear; due to the crossing of the axes the shaving-cutter teeth engage the internal gear to a greater depth at the ends than at the centre, and there may be little or no contact at the centre of the cutter. Fig. 4, on page 826, illustrates the contact between a spur shaving cutter and an internal helical gear, the circle $a\,c$ being the working depth line. It will be seen that the points d and e at the ends of the cutter tooth are deeper in mesh than the point b at the centre. Similar conditions also apply to a helical cutter meshing with an internal spur gear; the combination shown in the illustration was chosen for convenience of drawing. In practice, the shaving of internal gears is accomplished by using a narrow cutter with a small crossed-axis angle and applying considerable pressure.

In gear shaving there are two methods of applying a lead to the cutter; one is by applying a brake to the spindle of the driven member, whether it is the cutter or the gear, and the other is to close the working centres of the gear and cutter so that contact is made on both faces of the teeth. A pressure applied along the common centre line gives a corresponding pressure normal to the tooth profiles. Radial leading makes it easier to apply a lead of an appreciable magnitude and gives a rate of production which is higher, because both faces of the cutter are working at the same time. In certain circumstances it is desirable to cut on one face only, for example, when it is necessary to modify the contact between the wheel and pinion to suit either errors in the gears or their alignment in the gear case or mounting. In this case, brake leading may be applied with an advantage; a further feature is that the thickness of the cutter tooth is not so important in relation to the wheel tooth as it is when radial leading is used. There is, however, a way of applying radial leading and at the same time cutting on one face only by having a special cutter with serrations on only one face. This makes the application of leading more positive, but it is still necessary to retain an exact relation between the thickness of the tooth of the cutter and that of the gear.

A great deal of the success of the shaving operation depends on the accuracy of profile of the cutter; the tooth profile produced by a shaving cutter is not necessarily that which corresponds exactly to the profile of the cutter itself, and if shaving is carried out with cutters having pure involute profiles they sometimes tend to have slightly hard contact near the tips. This may be partly due to the circumstances indicated in Fig. 5, on page 826. Fig. 5(a), with the space of the cutter central, shows four points of contact, and Fig. 5(b) shows only two points of contact, a greater cutting pressure being applied at each point of contact in the latter case. The maintenance of a keen cutting edge is necessary on account of the small

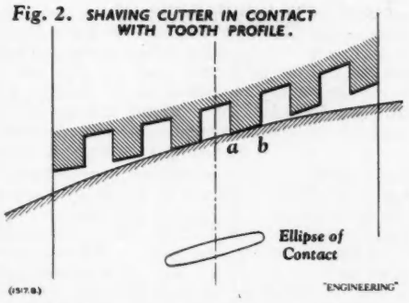


Fig. 2. SHAVING CUTTER IN CONTACT WITH TOOTH PROFILE.

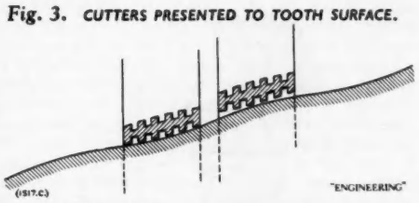
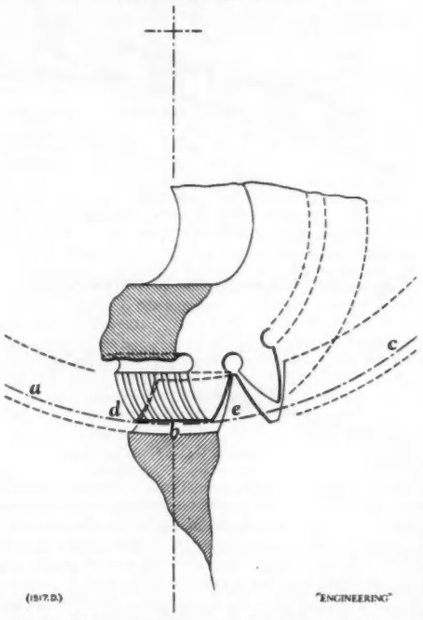


Fig. 3. CUTTERS PRESENTED TO TOOTH SURFACE.

* Paper presented at a meeting of the British Gear Manufacturers Association, held in London on May 19, 1953. Abridged.

GEAR SHAVING.

Fig. 4. SPUR SHAVING CUTTER AND INTERNAL HELICAL GEAR.

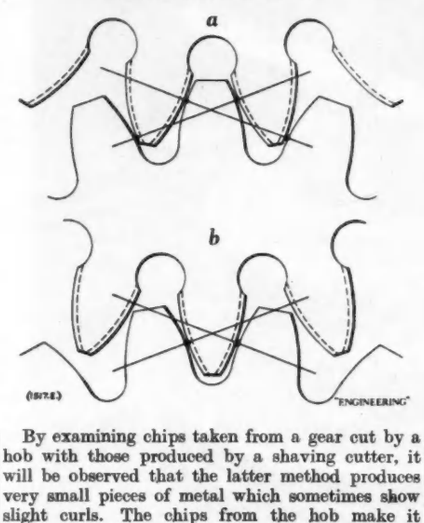


depth of penetration. The cutters can be re-sharpened by re-grinding the profiles in the same manner as they are ground initially. This means thinning the teeth slightly, but where an effective thickness is important this can be maintained by reducing the outside diameter by a corresponding amount.

Any normal gear-cutting process can be used prior to shaving, provided the resultant tooth profile varies only slightly from that required after shaving. A gear shaper type of cutter can be used as a shaving cutter but it has the disadvantage of having only a single cutting edge, whereas a shaving cutter has a number of cutting edges; the clearance provided in a gear shaper type of cutter tends also to make it cut more deeply and more freely than is generally desirable. If an appreciable amount of material is removed in the shaving operation, there may be a slight step left near the root of the tooth, but if desired this can be overcome by making a suitable protuberance or land around the tooth tip of the hob or cutter. It is, however, important that the amount of material left on the gear tooth for shaving should be the smallest amount possible, generally 0·001 in. to 0·002 in. on each face of the tooth, which will leave hardly any appreciable step, even without a protuberant type of hob.

A question is sometimes asked as to which is the most favourable direction of feed relative to the direction of cut. Fig. 6 shows a tooth of the cutter in contact with the gear, which is driving the cutter in the direction shown by the arrow. The two points *d* and *e*, which are separated from each other in the position shown, will coincide at the point *b* after the gear has moved through the length *b e*; the line *b d* is at right angles to the axis of the cutter and *b e* is at right angles to the axis of the gear. The relation between the cutting speed and the peripheral speed of the gear and the cutter depends on the crossed-axis angle. With an angle of 15 deg. the cutting speed will be approximately one-quarter of the circumferential speed. Assuming a circumferential speed of 200 ft. per minute, the cutting speed will be about 50 ft. per minute. The rate of feed might be 0·01 in. per revolution of the work; on a gear 4 in. in diameter this would mean that the rate of feed would be 2 in. per minute, so that the effect of the feed would be to increase or decrease the effective cutting speed by 2 in. per minute, which is insignificant in comparison with the actual cutting speed of 50 ft. per minute, so that direction of feed makes no practicable difference to the cutting conditions.

Fig. 5. CONTACT BETWEEN SHAVING CUTTER AND GEAR.



By examining chips taken from a gear cut by a hob with those produced by a shaving cutter, it will be observed that the latter method produces very small pieces of metal which sometimes show slight curls. The chips from the hob make it clear that the point of the tool does relatively more work than the sides. This is a feature of all generating processes, as the rate of approach of the cutter point is always greater than that at the sides.

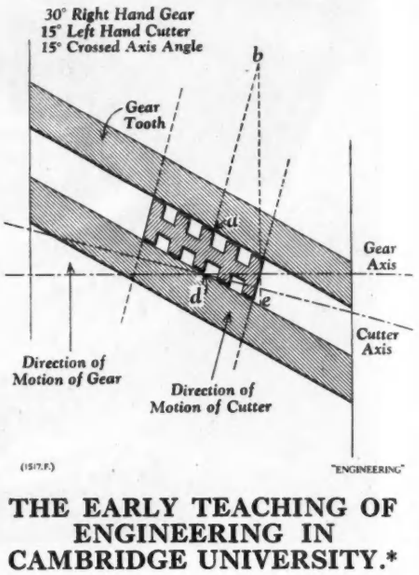
Where brake loading is applied, an interesting feature is that, with the gear driving the cutter as shown in Fig. 6, the work is approaching the cutting edge *d*, that is, on the side with positive rake, while if the cutter is driving the work, the cutting takes place on the negative-rake side at *a*. The following rule covers all cases: Where the helix angle of the gear is greater than the crossed-axis angle, cutting takes place on the positive-rake side if the work is driving the cutter, but where the helix angle of the gear is less than the crossed-axis angle, cutting takes place on the negative-rake side. The reverse conditions apply if the cutter drives the work. In the case of radial loading, where both faces of the teeth are in operation, one face is being shaved by the negative-rake edge and the other by the positive-rake edge, but, as already stated, no significant difference has been observed between the cutting ability of the positive-rake side and the negative-rake side.

A feature which has been found desirable to introduce into the shaving process is the need to carry out crowning or end relief, to avoid hard contact at the extreme ends of the teeth. In the method adopted on the David Brown machine, a cutter head is swivel-mounted and normally held out of position against a solid face by spring loading, and a cam can advance the cutter into the work slightly by the use of an adjustable dog operating on a roller at the end of a lever. The amount of relief needed in all practicable cases is very small, about 0·001 in. to 0·002 in. for wide gears and 0·005 in. for narrow gears.

MAGNETIC LATHE CHUCK.—A small circular lathe chuck of the magnetic type has been produced by James Neill & Co. (Sheffield), Ltd., Napier-street, Sheffield, 11, following on the recent introduction, by them, of the "Eclipse" heavy-duty rectangular magnetic chuck. It is 4½ in. in diameter and weighs 8¼ lb., and is suitable for small precision work. The heavy-duty model, built on the unit principle, can be made up to any desired length in 18-in. sections, and is suitable for use on heavy grinding, planing and milling.

CENTENARY OF W. F. STANLEY & CO., LTD.—*A Century of Scientific Instrument Making*, 1853-1953, is the title of a book which has been written by Mr. Cecil J. Allen for W. F. Stanley & Co., Ltd. The story of the growth of this firm, from the small London shop rented for 12*s.* a week by William Ford Stanley in 1853, to an organisation which now produces a very wide range of scientific instruments, is well told and well illustrated. An article in connection with the centenary was published in ENGINEERING on page 487 of the issue of April 17.

Fig. 6. TOOTH OF CUTTER IN CONTACT WITH GEAR.



THE EARLY TEACHING OF ENGINEERING IN CAMBRIDGE UNIVERSITY.*

By E. G. STERLAND, M.A., A.M.I.Mech.E.

(*Concluded from page* 797.)

THERE were six candidates for the professorship, of whom four were chemists, including James Dewar, demonstrator of chemistry in the University of Edinburgh, who was subsequently elected. Mr. J. C. Williams Ellis, who had been deputy for Professor Willis, was a candidate, as was James Stuart, who subsequently became first Professor of Mechanism. Both these latter candidates subsequently withdrew from the election on finding that the intention of the University was to appoint a professor who would be more interested in pure science than in mechanisms.

The Council reported on March 15, 1875, that "they beg leave to add that they propose to offer to the Senate early next term a Grace appointing a Syndicate to consider the propriety of establishing a Professorship of Mechanism and Engineering." This Syndicate was set up on April 29, 1875, and its terms of reference were: "To consider whether any, and if any, what steps should be taken for establishing a Professorship of Mechanism and Engineering." The Syndicate reported on May 6, 1875, and recommended "that there shall be established in the University a Professorship of Mechanisms and Applied Mechanics. It shall be the principal duty of the Professor to teach and illustrate the following subjects: (1) the Principles of mechanism; (2) the Theory of Structures; (3) the Theory of Machines; (4) the Steam-Engine and other Prime Movers; to apply himself to the advancement of the knowledge of such subjects, and to promote their study in the University. Stipend, £300 per annum."

In the discussion on the report, Dr. Campion strongly objected to the words "applied mechanics" instead of "engineering"; "If Engineering was not to be part of the subject entrusted to this Professor," he said, "the University would before long be told that a new Professorship of Engineering must be established."

Mr. Trotter (one of the Syndicate) said that "The Syndicate thought 'Engineering' a very vague term, with no ascertained technical meaning. They desired to have a Professor who would be useful in case a school of Engineering arose in the University, and with this view they named such subjects as would include all that fairly came within the compass of a Professor of Engineering, supposing that term to have any definite meaning."

* Address delivered to the Newcomen Society at their Summer Meeting in Cambridge, May 29, 1953. Abridged.

Mr. Freeman, also a member of the Syndicate, said that "They had excluded from Engineering such parts as were too practical to form one of the studies of the University, such were the construction of railroads, canals, docks and drains." He read a letter from Mr. W. H. Moorsom, Superintendent of the London and North Western Rails Department at Crewe, expressing a strong sense of the benefit of such a school in the University. Mr. Pirie sympathised with the object of the report, to found a school of Engineering, but was not satisfied with the way in which the Syndicate proposed to do it.

Opposition to the proposal to establish a Chair of Mechanism came from Robert Phelps, of Sidney Sussex College, who published a letter in the *Cambridge Chronicle* of October 30, 1875. It was headed "A Professor of Mechanism and Engineering," and read: "Sir, The Department of Mechanism and Engineering, we are told, is one of vast extent and importance, and the new Professor who would be the head of it ought to give his undivided attention and energies to it. Is the dream once more to be revived that a school of Engineering can and ought to be established at Cambridge? In my view of the proper functions of the Professoriate . . . such a dream is preposterous. As I have said before, the proper function of a Professor . . . is original research. . . . For this end, he must be supposed to be naturally endowed with those peculiar faculties and aptitudes which constitute special genius, and, the benefits which he confers upon mankind are presented, not in the transitory evanescent form of oral teaching to classes of students—a mode of teaching encumbered with insuperable difficulties and imperfections—but invested with a character of imperishable permanence by the Press, the greatest of all worldly powers, ancient or modern."

He goes on to assert that any of the "very many accomplished mathematicians" of Cambridge would be competent to teach the subjects prescribed, and that, in any case, there were plenty of books, and the collection of models purchased by the University from Willis's executors. What more could a student want? He went on: "To my mind it is absolutely ludicrous to think of setting up a practical school of mechanism and engineering here. . . . And now as to the question of a real Professor of Mechanism and Engineering, i.e., of a Professor endowed with the special genius . . . and whose function would be that of original research. Well, Sir, I really think that I need only express my amazement that any sensible man can be so weak as to believe that, in these days, when the possession of anything like such a genius would insure to its distinguished possessor an enormous fortune in any country in the world, the offer of 500*l.*—or even of 5,000*l.*—a year would induce such a man to give his 'undivided attention and energies' to the real interests of these truly important Departments in the University."

"P.S.—Since writing the above this morning, I have to add, with profound regret and humiliation as a member of the University, that the Senate has noted the establishment of a Professorship of Mechanism and Applied Mechanics, with a stipend of 300*l.* a year out of the University Chest. As I, of course, expected, the whole force of University Radicalism and the corps Professorial were in favour of the Grace. . . . I am happy in having publicly protested against the measure, and I have met with much sympathy from a great many quarters. . . . The *mens conscia recti*, in regard to this matter, shall be my consolation in defeat." The voting was *placet*, 74; *non-placet*, 36.

The election of the new professor was by popular vote of the electoral roll of the University. The election was held on November 17, 1875, and the results were: James Stuart, 111; Edward J. Routh, 81; J. C. Williams Ellis, 36. James Stuart was born at Balgonie, Fifeshire, in 1843. He entered Trinity College, Cambridge, in 1862, was third Wrangler in 1866, and was elected a Fellow of Trinity in 1867.

Stuart proceeded to establish workshops in Free School-lane. It is clear from his reports to the University that his concern was to give instruction in practical engineering. In December, 1880, for instance, he asked for more buildings, his requirements being: "(1) An addition to my fitting shop, where a number of my pupils have now advanced to making small engines and require more space for erecting them. (2) A room in which my pupils can be taught mechanical drawing. (3) An enlarged stove. (4) Some better accommodation for a lavatory."

It appears from a report by Stuart, of January 25, 1886, that, until that date, the workshops had been financed by him personally. It was decided that the University should take them over, and this was done on April 16, 1886. The valuation made by Messrs. Fuller, Horsey, Sons and Cassell, on the nomination of Sir Frederick Bramwell, President of the Institution of Civil Engineers, was 4,019*l.* 12*s.* 0*d.* The report of May 10 recommended that this sum be paid to Stuart, and that the workshops be regarded as an investment by the University, bearing interest at 3½ per cent. The report was passed by the Senate on May 13, 1886.

It is evident that there was friction between the workshops and the rest of the University. The volume of work given to the workshops by other departments decreased sharply, and the department began to make a loss. In February, 1889, the Financial Board were evidently not satisfied with the accounts of the department, and instructed a firm of chartered accountants to examine the books. From their detailed statements and explanations it emerged that James Lyon, who had been appointed Superintendent of the Mechanical Workshops in 1884, was not a very good accountant, but there were many points which were explicable.

The discussion on October 24, 1889, was acrimonious. The Master of Peterhouse said that "The accounts were, he thought, the worst he had ever seen; not that they were not correct, but they were in the worst possible form and violated all principles of book-keeping. They were in such a state of confusion that the accountants' charge for preparing a balance sheet was a little more than 100*l.*"

Professor Stuart, in his reply, set out clearly his views on engineering education. "It had been asked, could the lectures go on as well without the workshops? That was precisely the question which a dozen years ago or more he had had to ask himself when he was placed here as Professor of Mechanism. Expectations were formed . . . that his appointment to this post might be the means of bringing the University into practical contact with the engineering profession. He had to ask himself at that time, was this possible? He came to the conclusion that it could not be done, unless he could establish a means of providing that handicraft training which the large majority of engineers were obliged to get early in their course, at an age earlier than that at which they would be leaving the University. Also he felt that such lectures as were not purely abstract should be given to persons who were not wholly ignorant of the mechanism and use of the things treated of in the lectures. Thus, if he was to encourage these men to come to the University, he felt he must be able to give them here the first portion of their practical training. He was very far from saying that he would have proceeded so elsewhere than in Cambridge, because in other places there would be opportunities for seeing the inside of a workshop. He maintained that if they were to touch the engineering profession more than on the mere fringe, they must have the workshops. He approved of laboratory and testing work, but held the workshops to be the first need under the circumstances." On February 10, 1890, Professor Stuart sent a letter of resignation to the Vice-Chancellor, giving as his reason the increasing demands of political and public engagements. The resignation took effect from June 25.

There is no doubt that, during the period from 1886 to 1890, the mechanical workshops were in some disfavour in the University. There is nothing in the evidence to suggest that Stuart "made a good thing" out of them, but he certainly failed to give his position as Professor of Mechanism and Applied Mechanics all his attention. Further, according to present-day notions of teaching of engineering, it would seem that his ideas were misguided on this subject, in that he placed undue emphasis on practical engineering rather than on the teaching of the fundamental sciences. Stuart's resignation gave the University the opportunity of completely overhauling the mechanical workshops and of putting the teaching of engineering on a sound footing.

Stuart was succeeded by Professor J. A. Ewing, who was elected on November 12, 1890. He proceeded to ask the University for further accommodation in order to furnish a laboratory. Fortunately, at this time the Perse School, which occupied the site adjacent to the mechanical workshops, moved to its present buildings in Hills-road and the University allocated a large portion of the buildings to the Engineering Department.

The feeling of the University about the establishment of the School of Engineering may be judged from the following extract from the report of the Mechanical Workshops Enquiry Syndicate, dated March 13, 1891: "The development of a School of Engineering within the University of Cambridge has lately received much attention on the part of the University. It is believed that the time has come for giving the subject of engineering a place in the studies of the University similar to the place it holds in other Universities and Colleges, and for providing the Professor of Mechanism and Applied Mechanics with those appliances which are now recognised as essential to its satisfactory treatment. Without attempting to supersede the practical training which a pupil must receive in the office of an engineer or in engineering works, several English Colleges have striven with much success to supplement this professional training by offering a course of scientific study, chosen so that it may have as direct a bearing as possible on professional requirements. The need on the part of engineers of such a scientific basis in their training is now generally admitted. The University studies which are comprised in such a course are Mathematics, Physics, Chemistry, and the Theory of Engineering. Under this last are included such subjects as applied mechanics, the strength of materials, the study of structures in relation to their strength and stiffness, the principles of mechanism, the theory of heat engines, practical hydraulics, and applied electricity. The principles and, to some extent, the practice of surveying are also taught, as well as geometrical and mechanical drawing.

"A connected course of study dealing with these subjects affords a liberal education, and at the same time accustoms the pupil to apply scientific methods to the practical problems he will meet in later life. The study of mechanics gains much in utility, and loses nothing in educational value, by being approached from the standpoint of the engineer. To enable such a course to be pursued to the best advantage, an Engineering Laboratory is needed in which an experimental study may be made of the strength, elasticity and other properties of the materials of construction, of the action of steam engines, gas engines, hydraulic motors and prime-movers generally, of efficiency in the transmission of power, of the action of dynamo-electric generators and motors, of the efficiency of transformers, of friction, of the flow and resistance of fluids, of the accuracy of measuring appliances, such as indicators, pressure gauges and electric meters, and, generally, of any matters of interest to engineers which admit of quantitative experimental examination.

"The uses of such an Engineering Laboratory are four-fold. It makes the student's knowledge of mechanical principles more real by bringing him into contact with material examples. It gives him practice in those kinds of experimental work which he may afterwards have to perform in professional life. It teaches him how investigations are to be conducted, and gives him some experience in this higher work. And, lastly, it endeavours to contribute to the common stock of knowledge by affording opportunities and appliances for original research."

The Syndicate included, in addition to Ewing, J. J. Thomson, Osborne Reynolds, John Hopkinson, Horace Darwin and R. T. Glazebrook. Ewing was able to put the teaching of engineering on a proper footing, having obtained his laboratories and lecture-room accommodation, and the services of C. G. Lamb and W. E. Dalby as demonstrators. The modern era commenced with the approval of the University to a Mechanical Sciences Tripos in 1892. Since then, the teaching of engineering has been based, generally speaking, on the principles laid down by Ewing.

HEAVY-DUTY PLATE-BENDING MACHINE.

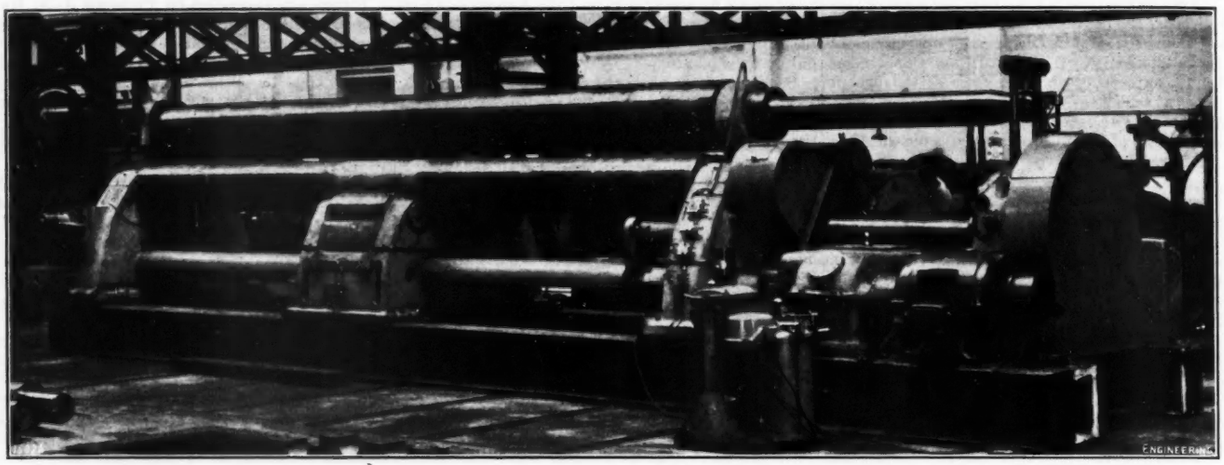


FIG. 1. REAR VIEW, SHOWING MOTOR.

HEAVY-DUTY PLATE-BENDING MACHINE.

MESSRS. Joshua Bigwood and Son, Limited, Wolverhampton, have recently introduced another heavy-duty pyramid plate-bender into their medium-size range. It is illustrated in Figs. 1 to 3, herewith, and is of the conventional three-roll design, but has a number of features previously only employed on the heavier sizes of machines. The maximum width of plate that can be handled is 18 ft., and the maximum thickness is $\frac{3}{4}$ in. The top roll has a diameter of 18 in. and the bottom rolls are 15 in. in diameter. The overall dimensions are 30 ft. 6 in. by 7 ft. 9 in. in plan, and the height is 7 ft. 6 in. The weight of the complete machine is 35 tons $1\frac{1}{2}$ cwt.

Cast-iron roll housings carry, in phosphor-bronze sleeve bearings with bearing caps, the two lower rolls, which are driven. The top roll, machined from a high-carbon steel forging, is carried in roll chocks working in machined slides in the housings between the lower roll journals, the chocks being secured by wrist pins to heavy adjusting screws. The thrust on the top roll is taken by roller bearings of large diameter which are mounted in the base of the housing, the roll-adjusting mechanism comprising a worm and wormwheel nut, totally enclosed in the housing casing. The lower rolls carry the double-helical driving pinions and are supported at the centre by a pair of rollers under each roll; the support-roller journals run in phosphor-bronze bearings in a single cast-iron cradle, mounted on the main bed. The lower rolls are provided with grooves, with the exception of that part bearing upon the support rolls, to assist in the alignment of the plate before bending.

The drive is by a unidirectional 35-h.p. alternating-current motor of the slip-ring type, connected directly through a semi-flexible coupling to a gearbox enclosing two pairs of clutches. These are of the expanding-shoe type, actuated by sliding keys. The steel clutch gears have double-helical teeth and run in oil. Each pair of clutches is controlled by a long separate hand-lever, one lever controlling the clutches for the forward and reverse movement of the rolls, and the second the adjustment of the top roll This system of clutches is designed to provide running and inching control of the bottom rolls, forward and reverse, and very fine adjusting control of the top roll, permitting also combined control at the early stages of bending of pressure adjustment on the top roll at the same time as the plate is being passed through the machine. The clutches are easily accessible for adjustment, which can be quickly and simply carried out when required. The high-speed shaft of the gearbox runs in roller bearings; the remaining bearings of the gearbox are ring-oiled. From the gearbox, a further speed reduction is made through

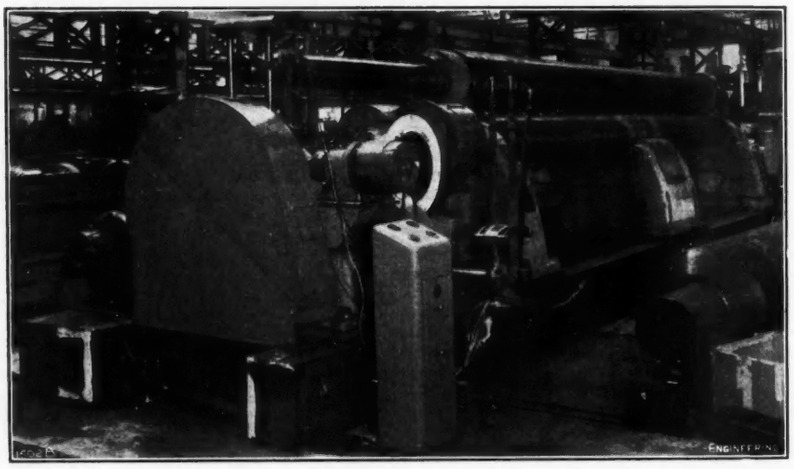


FIG. 2. CONTROL POSITION.

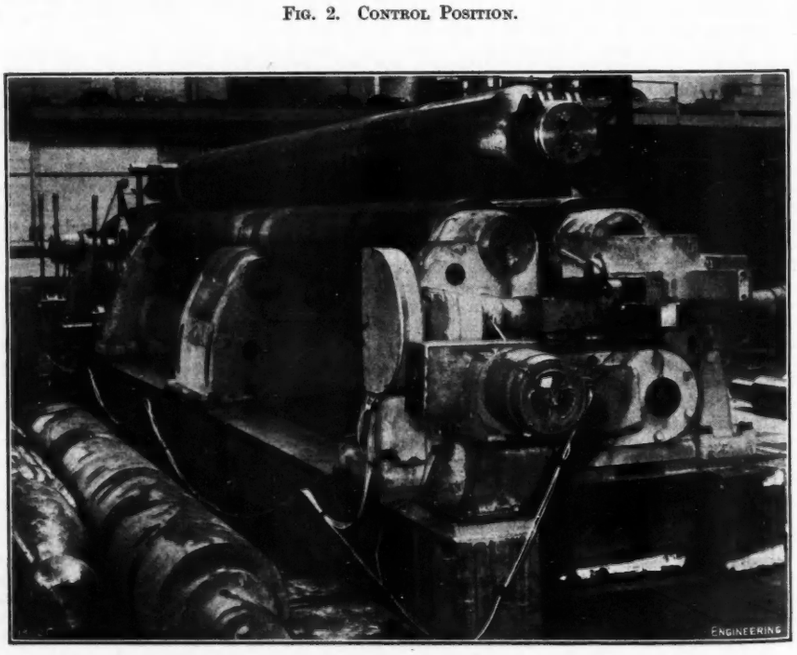


FIG. 3. POWER-OPERATED SWING END-BEARING.

machine-cut double-helical gearing, encased in steel guards and lubricated by a heavy grease. The outer gearshaft runs in phosphor-bronze bearings, carried in a pedestal which also carries the top roll jacking-screw gear.

To remove completed cylinders, the top roll is provided with an extension with a ball end. When the jacking pressure is applied, the ball end is engaged by a swivelling yoke, adjusted by two screws. Jacking pressure is applied by a 2-h.p. motor, driving through a reduction gear and controlled by a push-button reversing switch through worms and wormwheel nuts in the pedestal bracket. Before applying the balancing pressure, it is necessary to withdraw a locking pin at the swinging-bearing end of the top roll. When sufficient pressure has been applied to balance the top roll, the outer bearing is lifted slightly from its seat in the swinging-bearing block, which can then be swung clear from the top-roll outer bearing by a second adjusting motor, working through a worm and quadrant and two swinging arms; thus the top-roll bearing remains undisturbed on the journal, which is protected from damage by the withdrawn work or from extraneous dust and dirt, the swinging chock only being removed. The swing end-bearing motor shaft is fitted with an electro-magnetic brake, and the control, operated by a push-button, is protected by limit switches. The swinging bearing is balanced by a counterweight.

A box bed, built up from standard steel sections and plate, extends the full length of the machine, locating the gearbox, drive and housings so that accurate re-alignment of the components on site is assured. The use of such a bedplate enables a single foundation level to be employed. Protective devices are fitted to the machine to prevent damage by over-adjustment of the control movements, principally the adjustment of the top roll in its minimum and maximum positions by limit switches. A reset switch is fitted on the control-lever bracket so that the main motor can be re-energised with the adjusting control clutches in the opposite direction, if either limit switch is caused to operate.

In addition to rolling plates into form cylinders, conical work can be produced by tilting the top roll. A third control lever actuates a clutch in the top-roll adjusting shaft, which disengages the roll adjustment of the outer end of the top roll from its inner end, thereby enabling it to be tilted (the roll chocks being secured to the adjusting screws by wrist pins) to the desired angle. Indication of the top-roll position can be either mechanical, or electrical by Magslips.

In the case of the machine illustrated above, a single large dial-type indicator carries two pointers, showing the position of each end of the top roll. Lubrication of the roll and support-roll bearings and all major bearing points is by a single centralised lubricating system supplied by Farvalube, Limited, of Hereford.

RECORDER FOR GAUGING MINE SHAFTS.—A recorder has been invented by Mr. T. Currie, of the National Coal Board's Scottish Division, for determining the alignment and condition of the cage guides in mine-shafts. Two rollers are forced against the guides under a spring load of 400 lb., and through a suitable mechanism the rollers actuate pens which record the shift on a moving paper strip. With the gear ratio employed, 0·65 in. of paper is equivalent to a cage travel of 6 ft. The whole unit is readily attached to the cage by four bolts and can therefore be moved from shaft to shaft for regular inspections.

THE LATE MR. R. A. DEANS.—We note with regret the death of Mr. Robert Arthur Deans, which occurred at the Royal Homeopathic Hospital, London, on May 30. Mr. Deans, who was 60 years of age, was manager of the special-lamp department of the British Thomson-Houston Co., Ltd. Although he had worked with this firm for more than 20 years, he was well known outside of the electric-lamp industry. Mr. Deans was the first British representative of the Simon Saw and Steel Company of America and he had worked for a number of other firms in the machine-tool industry. In 1933, he joined the British Thomson-Houston Co. to develop the company's special-lamp business and particularly studio light-sources which were then in the early stages of development. During the last 20 years of his life he introduced practically every new type of studio lamp to the film industry.

THE BRITISH ELECTRICAL POWER CONVENTION.

(Concluded from page 791.)

OPENING the discussion on the four papers on "Electricity and Industrial Production," which were presented at the meeting of the British Electrical Power Convention on Wednesday, June 10, and were summarised in our last issue, Mr. P. H. Goddard said that increased productivity would depend on the supply of cheap electricity. While the price of electricity had not, on an average, been increased by more than 20 per cent., the price of coal, on which the industry would have to depend, had gone up by at least 300 per cent. It was ridiculous for one branch of the fuel and power industry to make economies, only to find them frustrated by another branch.

Captain J. M. Donaldson suggested that too many papers were being presented at the B.E.P. conventions, so that there was not sufficient time to digest or discuss them. Undoubtedly, the coal situation was becoming increasingly serious, and we might have to pin our faith to nuclear energy in the future, since other palliatives would not play a large part. The efficiency of generation was increasing steadily, but the only real way out of the present difficulty was to work harder.

Dr. J. N. Aldington thought that the effect of lighting on industrial production had not been sufficiently emphasised in the papers. At the present time, the level of illumination in most industrial plants was much lower than it should be. The objective should be a lighting load of the order of 4 watts per square foot, leading to a figure of about 100 lumens per square foot at the working plane. Mr. R. A. S. Thwaites said that consumers with a load factor of 1 per cent. must give a very high diversity of demand, while, at the other extreme, consumers with a load factor of 100 per cent. gave no diversity. The question arose whether, in the latter case, some of the fixed charges in the theoretical two-part tariff should not be transferred to the running charges, and whether, with very low load factors, it would be reasonable to have ceiling prices.

Mr. J. O. Knowles pointed out that the versatility of motor control gear in the form of low-tension distribution boards was so great that the buyer could call for a large variety of features, the result being that most boards had to be "tailor-made." Manufacturers of switchgear and control gear would welcome all that the supply industry and other industries could do to help towards some measure of standardisation, and he looked forward to more co-operation between manufacturers and users so as to limit the variety of the requirements which affected auxiliary circuits.

Mr. Bryan Donkin suggested that the best field of application for heat-electric generation was to domestic premises. It would be uneconomic for a number of Lancashire and Yorkshire textile works to put in their own generating plant, because there would not be an adequate return on the capital expenditure. On the other hand, in new factories working three shifts, where the steam-using plant could be designed to operate at low pressures and temperatures, the position was different. To maintain a temperature of 65 deg. F. in living rooms, calculations must be based on a continuous minimum ambient temperature of 30 deg. F., but with properly-designed plant the input could be varied during the day to avoid excessive heat. A reasonably accurate estimate of the requirements of domestic premises could be made and metering thus dispensed with. If the conventional electric heating load were allowed to grow unchecked it would have disastrous effects on the plant installation programme of the British Electricity Authority. Although district heating might, therefore, be regarded as a nuisance, he thought that it should be considered.

Mr. A. M, F. Palmer said that it was necessary to work hard and efficiently when at work; and to do that full use must be made of electric power at every stage of the productive process. The electrical industry was handicapped not only by Government restraint on promotional advertising, but by its own meek attitude to its critics. It should be made clear in Parliament and elsewhere what the electricity industry could do, and was doing, to improve productivity.

Mr. H. W. Swann said he had been told by the chief engineer of a large industrial concern that, over the past three years, his organisation had spent 230,000*l.* on switchgear replacement owing to the rise in the general fault level of the supply. Anything that could be done to peg fault levels would encourage the industrial consumer. He wondered whether, in the near future, circuit-breakers would not be replaced by fault current limiters, controlled by some electronic device which, instead of allowing the fault current to reach a maximum value and then interrupting it at considerable cost, would restrict it. The reliability of electronic devices was very important and the specification of the gear for the fighting Services compared very favourably with that intended for industrial use.

Mr. J. I. Bernard suggested that one important reason for the high American figure of horse-power per worker was not that the horse-power per machine was higher than in this country, but that an operative looked after a greater number of machines. He also thought that all the back-pressure installations likely to be financially successful under present conditions of taxation were already in operation. More electronic control of industrial equipment was possible, as was shown by the latest blast-furnace skip-hoisting and charging plant, in which the pressing of one button started a sequence of 700 automatic operations; so that the furnace was charged with the right amount of materials at the right time.

Mr. A. N. Irens did not consider that Britain was behind the United States in mechanisation, except perhaps in materials handling. He thought that Mr. Johnson and Mr. Holder had understated the case for public supply as opposed to private generating plant, but urged public supply engineers to adopt a fresh approach to the question of parallel running to see whether a solution satisfactory to both parties could not be obtained.

Mr. J. W. Moule expressed disappointment that so little was being done in using "off-peak" electricity for space heating, since that would not only improve the load factor, but would secure increased productivity. Miss M. V. Griffith emphasised the advantages of the heat pump and regretted that so little had been said about it in the paper on combined heat and electricity supplies.

ELECTRICITY AND FOOD PRODUCTION.

At the meeting on Thursday afternoon, June 11, the first paper to be presented was by Mr. S. F. Steward on "Electricity and Food Production." All authorities agreed, he said, that Britain depended not only for prosperity, but for very survival as a first-class Power, on a rapid and substantial increase in the volume of home food production; and the purpose of his and the supporting papers was to show how much in this connection depended on the supply of electricity to the countryside. For much of the past 70 years, Britain's industrial equipment and manufactured goods had found ready markets overseas and had brought in return plentiful supplies of cheap food. The effect had been to change the pattern of farming in this country and to cause the reversion of millions of acres of arable land to grass and rough grazing. That trend was arrested during the 1914-18 war, but between the wars the countryside became depressed and deserted, so that in 1939 living standards in many places were deplorably low. For a second time, however, the farmers had responded valiantly, mechanisation had risen by leaps and bounds and the labour force had notably increased, so that by 1944 an increase of 25 per cent. over the pre-war output had been achieved.

The situation to-day was made more critical by a world-wide shortage of food. Moreover, Britain could not, in any event, contemplate an increased expenditure on imported food. From every point of view, therefore, agriculture, and indeed, commercial horticulture, justified super-priority. As it was, however, land was being transferred from food production to other purposes and, most serious

factor of all, the population was drifting to the towns. To reverse that movement, the land under cultivation must be better farmed and 16 million acres must be reclaimed and improved. That would require considerable capital investment and the provision of necessities and amenities, in order to increase the labour force. Electricity would be required for these purposes and for many others, for without it a large increase in food production could not be obtained.

To indicate the need for development, it was pointed out that, in 1941-43, only 78,000 out of 290,000 holdings of over 5 acres, or 27 per cent., enjoyed the use of electricity. Of those, nearly 9,000 had to make use of a private supply with its many limitations, while of the 70,000 holdings connected to the public mains more than half used electricity for lighting only. Since that time, there had been a welcome improvement and on December 31, 1952, the connections amounted to 118,000, or 41 per cent. of the total holdings, while in 1951-52 the increase in electricity sold on farm tariffs over the previous year was 17·8 per cent., compared with an increase of 8·2 per cent. for all classes of consumers.

The author then examined in detail some of the problems encountered in pursuing a vigorous rural development policy, and in this connection made detailed reference to the work which had been carried out by the South Western Electricity Board. Experience in that area showed that, as rural development extended into "thinner" territories, the economic problems became more difficult, although it was particularly in that sphere that electricity was likely to have the most influence on the increase of home food production. Given a reasonable balance of rural and urban development, and a fair proportion of industrial load, a Board should be able to regard a substantial programme of rural development, having an initial return of 20 per cent., as a fair commercial risk. The South Western Area had a high proportion of rural territory and relatively little industrial load, so that a substantial rural programme could only be undertaken on the basis of a line rental scheme, which secured a minimum continuing return of that amount. On that basis, the Board had been able to proceed rapidly with farm connections without undue financial risk, and at the same time had provided consumers with a strong incentive to use the supply fully.

Such an arrangement would continue to serve its purpose in making possible the electrification of farms and villages, which would otherwise be uneconomic for some years ahead. Much of the territory now remaining was, however, so sparsely populated that the position was being reached when rural extension would be halted because the charge had become prohibitive. Rural electrification was, however, more important to-day than ever before. It followed that the nationalised electricity supply industry must look at that matter nationally, if only to ensure that the capital resources devoted to rural electrification were employed to the best advantage. When all that had been done, there would remain an outer fringe of development which would never be self-supporting from the electrical viewpoint; and if, for reasons of food supply, it was imperative for electricity to be made available in such remote areas, then the State must take a hand.

Electricity for Agriculture.

Mr. Steward's paper was followed by one on "Electricity for Agriculture" by Mr. C. A. Cameron Brown, in which he defined "high farming" as a stepping up of productivity to make the land yield the maximum output of food, irrespective of relative profit. It was unrealistic to expect existing farms to develop their own "high farming" potentialities without the support and labour-saving afforded by electricity. Statistics showed that, in any international ranking list of rural electrification achievement, Great Britain must take a humble place. He therefore underlined the primary and urgent importance of affording an electricity supply to all farms, and made a case for regarding the agricultural load as potentially self-supporting. There were, however, some respects in which Britain was substantially in advance of other countries; they included the application of electricity to milk production, crop drying and all the more general power processes in and about the farm. Further, the load had been developed on lines most suited to British methods of rural distribution, by adopting the system of one farm to one transformer and keeping all the transformers as small as possible, with the doubly satisfactory result of reducing both total losses and capital outlay.

Great credit was due to the commercial engineer for having developed farm loads in such a way as to give his distribution colleagues every support. For instance, 15 to 20 years ago there was a tendency to use the American hammer mill, taking up to 20 or 30 h.p., for grain grinding; not a comforting prospect for either the distribution engineer with his transformer in mind or the commercial engineer trying to sell a 20-h.p. single-phase motor. As a result of experimental work, however, it had become possible to do the bulk of grain grinding by a 3-h.p. automatic hammer mill, of which over 8,000 were now in use. As a result, there had been a reduction in demand of at least 2,000 kVA and in demand charges of some 8,000*l.* per annum, as well as savings in plant and line costs. Steam sterilisation on dairy farms, and grain drying, were two other ways in which the requirements of the distribution engineer—low demand and low transformer losses—and of the commercial engineer—revenue—had been reconciled.

The dairy farmer owed to electricity not only amenity value, but such tangible assets as the reduction of dirt-producing services and the provision of adequate light. The main assessable gain was, however, the freeing of labour, which, on a farm of 75 acres, might amount to 21·75 man-hours per week or more. There were, of course, other gains. Electrical methods of rearing saved, on the average, one pig out of every winter litter. Modern intensive egg production was dependent on electricity for its being, but possibly the major contribution of electricity to the small and medium farmer was that he could now use a grain drier at a cost well below that offered by any other method.

With not more than 40 per cent. of the farms connected, British agriculture could not be regarded as being within sight of a general state of high connection. More discouraging was the fact that the average farm consumption during 1951-52 was only 4,700 kWh, from which it could only be concluded that, of the many technical advances afforded by electricity, only a fraction had reached the farming world as a whole. The result was due not to the price of electricity, but to the capital cost of the equipment, a state of things which might be met by lower prices, hire-purchase or even hire.

Electricity in Horticulture.

The next paper read on the morning of June 11 was by Mr. A. W. Gray, and was entitled "Electricity for Horticulture." Something must be done, he said, to halt the decline in that industry by increasing its overall efficiency and so cutting production costs to a point where it was economic for the grower to produce to the maximum. Electricity could help the horticulturist by giving him improved lighting and thus enabling work to be carried out longer and more efficiently in propagating houses, potting sheds and glasshouses, and in assisting packing and repairs. The installation of pumping equipment would ensure an adequate supply of water, while hot water for space heating could be obtained from electric boilers and immersion heaters, and the efficiency of the system improved by an electrically-driven accelerator or circulating pump. Where solid fuel was used, thermostatically-controlled electrically-driven mechanical stokers made for a saving in labour and fuel costs, with a freedom from "temperature worry" even under the most arduous weather conditions.

Electricity was also the most practical means of providing the essential root temperature by soil warming and, as far as the electricity supply industry was concerned, provided a night and off-peak load which was generally within the scope of the existing network. It could be used both on the propagating benches and in the hot beds, as well as to provide the correct root temperature for the plants when first put into their final quarters in the glasshouse borders. Electricity would also solve the problem of providing adequate ventilation in the glasshouses, and could be used to control pests by employing solidified insecticides and fungicides in small thermostatically-controlled electrically-heated containers which gave off aerosols. Certain pests could also be dealt with by immersing them in electrically-heated warm water at a precise temperature and for a predetermined time. Much research was being carried out on the control of flowering plants by light irradiation, while electricity provided two methods whereby small quantities of soil could be economically sterilised. Refrigeration was playing an increasing part in modern horticulture, as it enabled the grower to provide the correct temperature for the storage and treatment of crops.

In July, 1952, the area of commercial heated glasshouses in England and Wales was 3,918 acres, with a further 701 acres of unheated glasshouses and 570 acres of frames, bells and cloches. Those would show a load of 995 MW with an annual consumption of 1,209 million kWh. To them could be added 4 kW per acre for ancillary equipment, giving a total connected load of 1,016 MW and an annual consumption of 1,230 million kWh. Although it was impossible to obtain maximum electrification owing to cropping routine, it was possible to visualise an ultimate electrification of 60 per cent. of the total glass, giving a connected load of 610 MW and an annual consumption of 738 million kWh. In addition, a further load of 89 MW, with a consumption of 37 million kWh, could be obtained from spraying, storage and processing equipment, and for lighting and heating, giving a total load of 699 MW with an annual consumption of 775 million kWh. Although the load factor would be low, 95 per cent. of the consumption would be at night or during the "unrestricted" months.

The final paper, on "Electrical Equipment for Food Production" was by Mr. F. E. Rowland and contained detailed descriptions of the electrical appliances that had been specially designed for that purpose. They included pumps, hammer mills, milk coolers, clippers and shears, soil and other sterilisers and vehicles, as well as equipment suitable for horticultural space-heating, soil warming and for workshop purposes. Details of wiring and installation material, motors and lighting fittings were also given.

Discussion.

The discussion on this group of papers was opened by Mr. J. T. Beresford, who said that if the other Area Boards (excluding London, which had all six of its farms connected) had made the same progress in rural electrification since vesting day as had been made in the South Western Area, more than 50 per cent. of the farms of the country would by now be electrified, instead of 42 per cent. The Act laid it down that electricity supply was to be a national, not a regional, service, and the wealthier Boards, with less responsibility for rural areas, should support those who were less wealthy. Since the war 10,000 farm workers had left the land every year. It was not the farmer alone who needed electricity, but the whole of the rural population. To improve matters the Central Authority might well make the 33-kV lines a national charge on the whole industry; and something should be done about the bulk supply tariff to help the rural Boards.

The Rt. Hon. Thomas Johnston said that, in the area for which he was responsible, there were hundreds of thousands of acres of grazing land which could raise enormous herds if winter feeding could be provided. They had been trying for the past four years to produce an electric hay or grass drier to improve the yield and the protein value of the hay, and had met with encouraging success. The increase in productivity had been astonishing; one farmer testified that, for a capital expenditure of 500*l.*, he had saved 883*l.* in one year on concentrates and by the increased value of his sheep, while another said that electricity had been the equivalent of two extra hands on his farm. The losses by the traditional method of drying hay amounted to 40 per cent.; with electric drying, they had been halved, while the protein losses, which were anything from a fifth to a half, had been reduced to almost nothing.

Mr. J. S. Pickles remarked that he had been concerned with rural development for nearly 20 years and had lived in perpetual fear of a deficiency, though it had never occurred. In eight years from vesting date, the supply industry would have connected as many farms as had been connected during the previous 48 years. He thought that much of this development should be done on the single-phase system, as the three-phase system was too expensive. He did not think that prosperous industries like electricity and agriculture could ask for a subsidy, which meant "strings" and a weakening of the feeling of responsibility.

Mr. J. A. Duncan thought that, to increase the use of electricity, much greater security must be given to the farmer. The commercial side of the electricity industry must carry out more propaganda, and the manufacturers should make a greater effort to reach the farmers. Farming to-day depended almost entirely on the use of imported oil, a very vulnerable supply in time of war. If it were possible to substitute electric for oil tractors it would provide a magnificent load for the supply industry.

Mr. F. W. Godden commended Mr. Steward's line rental scheme as a new approach to the problem of obtaining a minimum continuing revenue and as being likely to be more easily understood and accepted than the system of a minimum revenue guarantee over a period of years. It might well, he thought, be considered for national adoption. The possibilities of an electric tractor should be investigated.

Annual Dinner.

In the evening the annual dinner was held at the Imperial Hotel, the President being in the chair. The toast of "The Electrical Industry" was proposed by Sir Archibald Forbes, who said that a freely available supply of electricity was essential to industrial development. The resources of the country were limited, however, and, although everyone would be glad to see bigger and better power stations, there had to be some re-equipment in general industry. The country owed much to the skill, courage and determination of the electrical manufacturing industry.

The President, in reply, said it was still necessary to strike a warning note with regard to the plant position, for in a period of extremely cold weather there might still be difficulties. It was essential, therefore, that they should be allowed to expand their programme in order to be able to replace the 3,000 MW of plant which was over 25 years old. The electrical industry was conscious of the need to maintain the maximum amount of exports. British manufacturers received nothing like as much support from their Government as did some foreign competitors; and much more could be done by giving the necessary export facilities than by trying to enforce greater efforts in the export market at the expense of the home market.

The toast of "The Guests" was proposed by Mr. P. V. Hunter. The Mayor of Torquay (Alderman P. T. Read) replied.

"Electrical Forum."

On Friday morning, June 12, the experiment of holding an "electrical forum," inaugurated last year, was repeated; and a panel consisting of Mr. J. Eccles, Mr. E. W. G. Golding, Dame Caroline Haslett, Colonel B. H. Leeson, Mr. S. F. Steward and Mr. E. R. Wilkinson, with the President as question master, answered a number of "unseen" questions. Dealing with the progress that had been made in the utilisation of wind power, Mr. Golding said that one 100-kW generator had been erected and was under test, and another was to be installed. A 250-kW machine had been designed and a 1,000-kW machine had been considered. The most economical size might be about 3,600 kW, which would produce energy at the cost of about ½*d.* per kilowatt-hour. Colonel Leeson thought that the contribution which windmill generation could make must be very limited, but Dame Caroline Haslett emphasised its psychological importance.

In reply to a question whether it would not be wise to organise one annual exhibition within the industry, Colonel Leeson said that such a display would be so large that it would be physically impossible to walk round it. It would be better for the electrical industry to link itself with others in which its main consumers were to be found. Dame Caroline Haslett, however, thought that a first-class exhibition every five years would have an enormous impact on the public. Such an exhibition should be organised fairly soon, so as to change the attitude adopted during the last five years. Mr. Golding suggested a mobile exhibition dealing with rural electrification and the President said that the exhibition organised by the Association of Supervising Electrical Engineers might be taken up by the industry in general.

Dealing with a question regarding tariffs for off-peak consumption, Mr. Eccles pointed out that, if only half the consumers elected to be charged on a differential day and night tariff, the cost of the metering equipment would run into tens of millions of pounds to get the benefit of something like 0·05*d.* per kilowatt-hour on electricity taken at night. Mr. Wilkinson said that, to obtain the same revenue as before, the present running charge would have to be increased for day-time consumption. Mr. Steward argued that, to obtain the same overall revenue, there would be a danger of prejudicing the existing cooking and water-heating loads; and Dame Caroline Haslett said that, before introducing such a differential tariff, it would be necessary to provide domestic equipment which would allow the consumer to benefit from it. In reply to a question as to how the panel viewed the tendency of British firms to establish manufacturing branches in the Dominions, the general opinion was that this was desirable. The supply of sparse rural areas by single-phase lines with earth returns was deplored, particularly from the point of view of safety.

Annual General Meeting.

At the annual general meeting which followed, Mr. J. R. Beard was elected president and Sir Harry Railing vice-president for the ensuing year. It was announced that the 1954 Convention would be held at Eastbourne during the week beginning June 14.

Maintenance of Railway Track.—An article on railway-track ballast—the various materials in use, desirable properties, correct thickness, etc.—is included in the second issue of *Matisa Review*, the journal of the Swiss firm whose associates in the United Kingdom are Matisa Equipment, Ltd., 78, Buckingham-gate, London, S.W.1. There is also an article on the mechanisation of permanent-way on the French National Railways and another on a modified version of the Matisa ballast cleaner. With this design, a system of conveyors enables cleaned ballast to be delivered at the front or back of the machine, and waste material to be discharged at either end into wagons situated on the same line or on an adjacent line.

Weatherproof Connecting Socket and Cable Coupler.—Messrs. W. W. Haffenden, Ltd., Sandwich, Kent, are now making a five-ampere three-pin connecting socket and a weatherproof cable coupler of hard rubber with the same current-carrying capacity. The connecting socket is designed to fit standard three-pin plugs, and is intended for use where an extended lead is required. The cable entries of both socket and plug are in line, so that there is no risk of fracture if a pull is exerted when the equipment is in use. The coupler has a tapered entry so that it can be connected to any thickness of cable. Tests showed that both these accessories could be completely immersed for 24 hours without any water penetrating and that the parting pull exceeded 25 lb.

The Late Mr. J. F Miller.—We note with regret the death of Mr. John Fletcher Miller, which occurred on June 5 at the age of 70. The eldest son of the late Mr. Robert Miller, of Ashton-under-Lyne, he was chairman and managing director of Fletcher Miller Ltd., manufacturers of metal-cutting and other oils used in engineering, Alma Mills, Hyde, Manchester. He was educated at Manchester Grammar School, and, after gaining technical experience, joined the late Mr. James A. Fletcher in marketing imported oil products. Later, the company which bears his name was formed. In this undertaking Mr. Miller was joined by his brothers, Mr. S. R. Miller and the late Mr. S. H. Miller. By hard work and sound planning they built up the present organisation which has branch works in London, Manchester, Huddersfield, West Bromwich and Glasgow. Mr. Miller was a member of the Institute of Petroleum and had made contributions to various conferences and symposia.

ANNUALS AND REFERENCE BOOKS.

"The Ship and Boat Builder" Annual Review, 1953.

John Trundell (Publishers), Ltd., Temple Chambers, Temple-avenue, London, E.C.4. [Price 30*s.* net.]

The latest edition of this annual review, now well established in its specialised field, contains a number of contributed articles, among which may be mentioned a useful survey of "The U.S. Market," by Mr. Ian L. Carr; another, "The Admiralty Turns to Diesel Engines," by Mr. Raymond V. B. Blackman, A.M.Inst.N.A., the editor of *Jane's Fighting Ships*; and a third, on "Light Alloy Craft in Tropical Waters," by Dr. E. C. B. Corlett, A.M.Inst.N.A. The usual reference sections, all of which have been revised and brought up to date, include directories of builders and repair yards in Great Britain, and of overseas builders, classified under their respective countries; marine-engine specifications, for outboard motors as well as main and auxiliary engines; sections on materials, fittings and equipment for small craft; and lists of associations, public bodies, officials, Chambers of Commerce, etc., with whom owners or operators of small craft (a classification which is interpreted as covering vessels up to 1,000 tons) are likely to come into contact.

The British Engineers' Association (Incorporated); Classified Handbook of Members, 1953.

The British Engineers' Association, 32, Victoria-street, London, S.W.1.

This, the 24th, annual edition of the British Engineers' Association's handbook, is divided into four sections, comprising an alphabetical list of members, an advertisement section, a classified list of members' manufactures, and an alphabetical catalogue of trade names and marks. As it stands, this fourth section appears to cover only a portion of the many trade names and trade marks represented in the Association's membership, but there can be little doubt that its usefulness will encourage others to seek inclusion. An introductory section describes the purpose and structure of the Association and indicates some of the more important of the many services that it is organised to provide for the benefit of the members and of those who may do business with them, and of the British engineering industry as a whole. The Director of the Association is Mr. A. W. Berry, M.I.Mech.E., M.I.E.E., and the secretary is Brigadier J. V. Topham.

British Chemical Plant, 1953.

The British Chemical Plant Manufacturers Association, 14, Suffolk-street, London, S.W.1. [Free to approved applicants.]

The previous issue of this reference book, which is intended largely for overseas circulation in the interest of British export trade, was published in 1951, and the practice of publishing at intervals of two years has now become standard. The principal contents comprise a list of members of the Association with their addresses and (where this information has been supplied) the addresses of their overseas agents; an illustrated section consisting of advertisements of chemical plant; and a classified index of the products and services offered by member firms, with introductory notes for the guidance of inquirers, and a glossary of technical terms in French, German and Spanish. This foreign-language key is an addition to the information formerly provided and should add materially to the usefulness of the directory.

The British Journal Photographic Almanac, 1953.

Edited by Arthur J. Dalladay, A.Inst.P. Henry Greenwood and Company, Limited, 24, Wellington-street, London, W.C.2. [Price 5*s.* net in board covers; 7*s.* 6*d.* net, cloth bound.]

During its 94 years of publication, this *Almanac* has become practically indispensable to amateur and professional photographers alike. The current edition, which fully maintains the standard of earlier volumes, includes an article on "The Profession of Photography," by the editors, and contributed articles by David Charles on "Forecasting Daylight Lighting"; by M. L. Haselgrove, B.Sc., entitled "The Bare Minimum"; on "Stereoscopic Projection at Home," by E. F. Linssen; and on "Mechanisation in the Photo-Finishing Industry," by Jack H. Coote. A section is devoted to editorial reviews of new apparatus and materials, which will form a useful guide to British and overseas buyers, and in a section entitled "Epitome of Progress" the year's progress in colour photography is reviewed and new and improved methods of working are described; a selection from recent patents is included. Chemical formulæ and working instructions for various photographic processes, including sub-standard cinematography, colour photography and document copying, are given. Other useful features

are a glossary of technical terms, exposure tables, tables of optical data, etc. The pictorial supplement, which is always an attractive feature of the *Almanac*, contains 32 photogravure reproductions of examples of work shown during the past year at the exhibitions of the Royal Photographic Society, the London Salon of Photography and the Polytechnic School of Photography. The reproductions include some excellent examples of portraiture and architectural photography.

Annuaire pour l'An 1953.

Bureau des Longitudes: Gauthier-Villars, 55, Quai des Grands-Augustins, Paris, (6e). [Price 750 francs.]

IN accordance with custom, the first chapter of this long-established annual begins with the calendar for the year and gives the times of the rising and setting of the sun and moon at Paris on each day of the year and of other planets on certain days. Astronomical predictions cover eclipses, the transit of Mercury across the sun's disc in 1953, and other phenomena. An extensive list of star positions is followed by an article on the tides, after which various calendars in use throughout the world are intercompared. In Chapter II, on the Earth, the section on geodesy has been enlarged; the article on solar radiation in the meteorological section has been revised; and the values of the components of the Earth's magnetic field have been brought up to date. Several articles, among them those on the minor planets, stellar spectra, novae and supernovae, and proper motions of stars, have been omitted from the chapter on Astronomy, while two articles on solar physics and stellar parallaxes, previously published in 1951, and revised by L. d'Azambuja and P. Couderc, respectively, have been reinstated. The information relating to time signals and comets has also been revised. As is usual in odd-numbered years, the first part of the final chapter is occupied with geographical data. It includes a new article on sea and ocean depths. The second part contains a comprehensive selection of French vital statistics and a revised version of an article on mortality tables by P. Delaporte. The supplement, containing summarised data for 1954, is followed by an article in which A. Durand-Viel outlines the development of the French Navy. The judicious blend of readable and authoritative descriptive material with a wide range of carefully selected tabulated information, continues to be a noteworthy feature of this useful reference book.

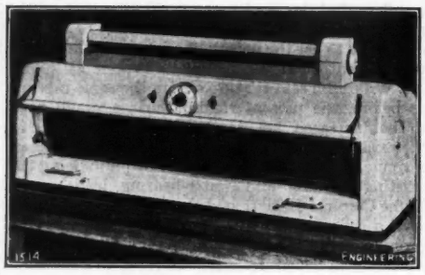
British Petroleum Equipment. 1953 *Edition.*

The Council of British Manufacturers of Petroleum Equipment, 79, Buckingham Palace-road, London, S.W.1. [Price 50*s.*]

FIRMS who are not in the petroleum industry, as well as those which are, will find this comprehensive catalogue and buyer's guide one of their most useful sources of information on British engineering manufacturers. Since the petroleum industry is one of the largest customers for civil, mechanical and electrical engineering equipment, the member firms of the Council of British Manufacturers of Petroleum Equipment constitute a considerable cross-section of the engineering concerns in this country. For example, the classified list of equipment and services provided by member firms includes such diverse items as barges, corrosion prevention, heat exchangers, laboratory and scientific instruments, road-making appliances, supervisory remote controls, and welding plant. Most of the 680 pages in the book are devoted to illustrated (some in colour) descriptions of the member firms' products. Each firm is allowed several pages in which to give, in effect, a brief catalogue of its products, in some cases with technical data. For a trade association only ten years old this book is a praiseworthy achievement that will serve many engineers in and out of the petroleum industry.

THE "APOLLO" PRINTER AND DEVELOPER.

THE Apollo printing and developing machine, illustrated herewith, has been introduced recently by E. N. Mason and Sons, Limited, Colchester, primarily to meet the requirements of the small office. It is of compact design, with the developing tray and rollers placed immediately above the printing blanket and cylinder, and, though it occupies only 17 in. by 50 in. of table space, it is stated to have an output up to 200 prints of double elephant size in a normal working day.



To operate the machine, the blanket is unwound from the spring-loaded cylinder by pulling outwards on the two handles provided, at the same time pressing the two thumb catches beside them. The tracing and the sensitised material are then placed on the blanket which, when the thumb catches are released, winds itself back on to the cylinder taking the tracing and the sensitised material with it. The time-switch is then set and the exposure commences. At the end of the pre-determined period, the lamps are automatically switched off, and the blanket, together with the tracing and print, is unwound from the cylinder by pulling outwards as before. The tracing and print are removed, and the blanket is returned to its normal position. The light source consists of standard fluorescent lamps of commercial quality, which are easily replaceable. The machine operates from an ordinary lighting circuit.

To develop a print, it is fed between the rollers, which are rotated by means of the small handwheel and crank on the right at the top of the machine. The rollers revolve in the developing solution, the level of which in the developing tray is kept automatically at the correct height.

1954 ELECTRICAL AND RADIO EXPOSITION IN AUSTRALIA.—The Electrical and Radio Federation of Victoria are arranging to hold an electrical and radio exposition at the Exhibition Building, Melbourne, in October next year. The exposition will be on an international scale and it is hoped to include apparatus from many countries, covering the latest developments in radio, television, illumination, tele-communications and refrigeration. No exhibition on a comparable scale and embracing the same fields has been held in Victoria since 1935. The address of the Federation, from whom further information can be obtained, is Dominion Chambers, 59, William-street, Melbourne, C.1., Australia.

BOOKS RECEIVED.

Investigations on Building Fires. Part V. *Fire Tests on Structural Elements.* By DR. NORMAN DAVEY and L. A. ASHTON. National Building Studies Research Paper No. 12. H.M. Stationery Office, Kingsway, London, W.C.2. [Price 15*s.* net.]

Ministry of Transport. Railway Accidents. Report on the Accident which Occurred on 16th July, 1952, *at Riccall Gates Public Level Crossing in the North Eastern Region British Railways.* H.M. Stationery Office, Kingsway, London, W.C.2. [Price 6*d.* net.]

Gas and the Warming of Large Buildings. Part 2. *Independent Units.* The Gas Council, 1, Grosvenor-place, London, S.W.1. [Price 2*s.*]

Alternating Current Electrical Engineering. By PHILIP KEMP. Eighth edition. Macmillan and Company, Limited, St. Martin's-street, London, W.C.2. [Price 36*s.* net.]

Engineering Law. By R. E. LAIDLAW and DR. C. R. YOUNG. Fourth edition. The University of Toronto Press, Toronto, Canada. [Price 4·75 dols.]; and Oxford University Press (Geoffrey Cumberlege), Amen House, Warwick-square, London, E.C.4. [Price 38*s.* net.]

Luminescence and the Scintillation Counter. By S. C. CURRAN. Butterworths Scientific Publications, 88, Kingsway, London, W.C.2. [Price 32*s.* 6*d.* net.]

Guide to the Coalfields. Edited by R. H. WALKERDINE and C. TREHARNE JONES. The Colliery Guardian Company, Limited, 30 and 31, Furnival-street, London, E.C.4. [Price 20*s.*]

Radioactive Isotopes. By W. J. WHITEHOUSE and J. L. PUTMAN. Oxford University Press (Geoffrey Cumberlege), Amen House, Warwick-square, London, E.C.4. [Price 50*s.* net.]

Electric Control Systems. By PROFESSOR RICHARD W. JONES. Third edition. John Wiley and Sons, Incorporated, 440, Fourth-avenue, New York 16, U.S.A. [Price 7·75 dols.]; and Chapman and Hall, Limited, 37, Essex-street, London, W.C.2. [Price 62*s.* net.]

The Cooling, Washing and Purification of Coal Gas. By G. U. HOPTON. North Thames Gas Board, 30, Kensington Church-street, London, W.8. [Price 6*s.* 4*d.*, post free.]

A Symposium on Prestressed Concrete Statically Indeterminate Structures, 24-25 *September,* 1951. Edited by DR. R. P. ANDREW and P. J. WITT. Cement and Concrete Association, 52, Grosvenor-gardens, London, S.W.1. [Price 25*s.*]

Introductory Electrical Engineering. By PROFESSORS CLODIUS H. WILLIS and HENRY M. CHANDLER, JR. D. Van Nostrand Company, Incorporated, 250, Fourth-avenue, New York 3, U.S.A. [Price 7 dols.]; and Macmillan and Company, Limited, St. Martin's-street, London, W.C.2. [Price 52*s.* 6*d.* net.]

Chinese Economic Development and Prospects of British Trade with China. British Council for the Promotion of International Trade, 15, Hanover-square, London, W.1. [Price 5*s.*]

The Iron and Steel Corporation of Great Britain. Report and Statement of Accounts for the Year Ended 30th September, 1952. H.M. Stationery Office, Kingsway, London, W.C.2. [Price 3*s.* 6*d.* net.]

The Iron and Steel Corporation of Great Britain. 1952 *Accounts. Year Ended 30th September,* 1952. The Iron and Steel Corporation of Great Britain, 1, Chesterstreet, London, S.W.1. [Price 16*s.* 6*d.*, including postage.]

Arid Zone Programme. I.—*Reviews of Research on Arid Zone Hydrology.* Unesco, 19, Avenue Kléber, Paris (16e). [Price 1,250 francs.]; and H.M. Stationery Office, Kingsway, London, W.C.2. [Price 25*s.* net.]

Hydro-Electric Potential in Europe and Its Gross, Technical and Economic Limits. Study by the Electric Power Section, Industry Division, United Nations Economic Commission for Europe. Sales Section, European Office of the United Nations, Palais des Nations, Geneva, Switzerland. [Price 4 Swiss francs.]

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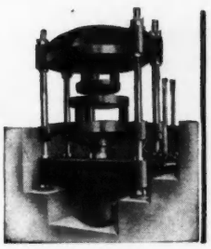

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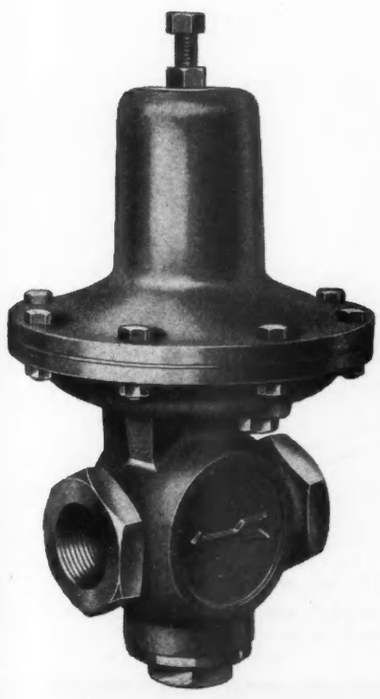

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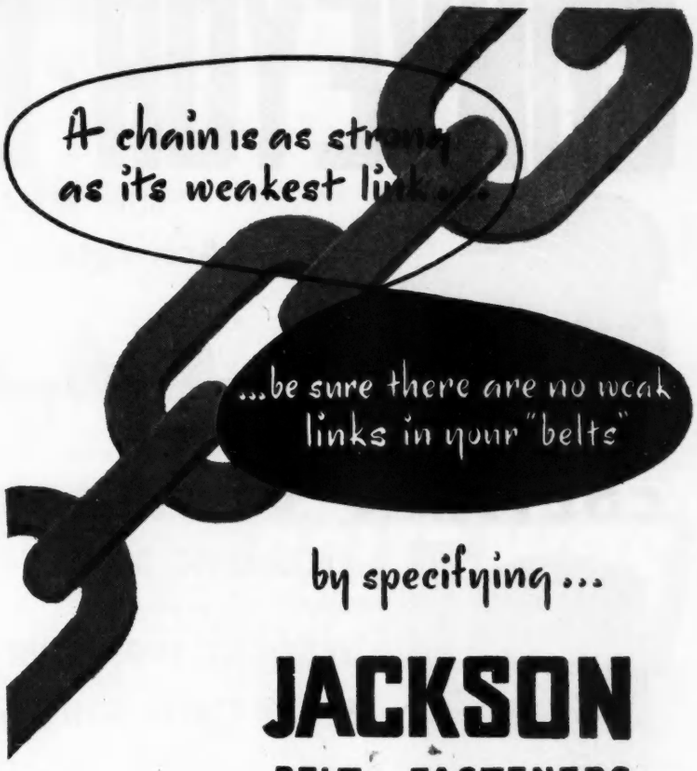

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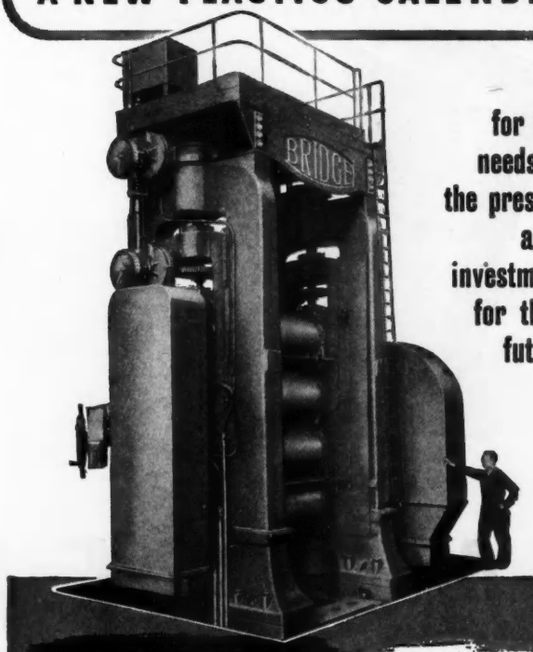

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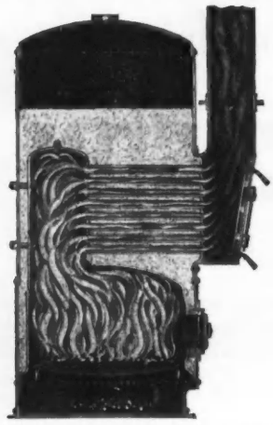

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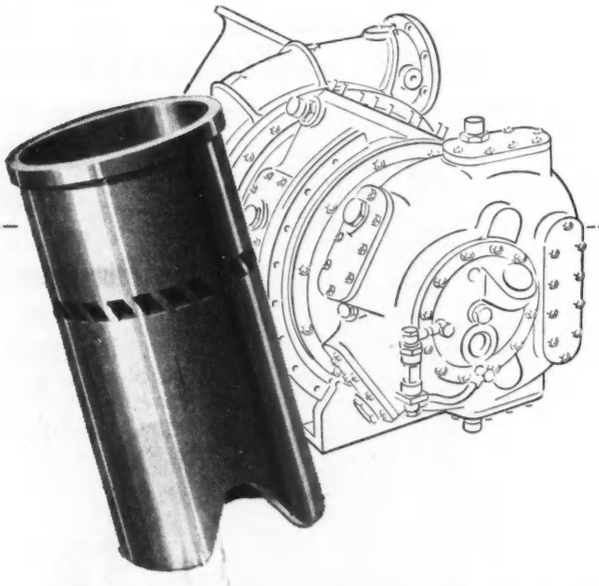

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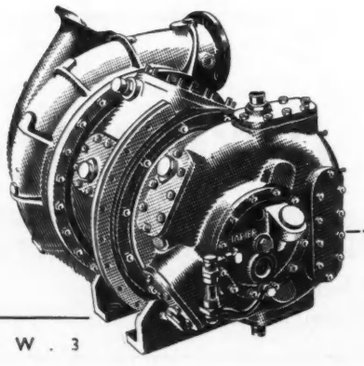

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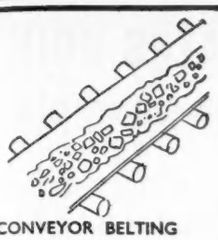

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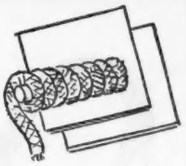

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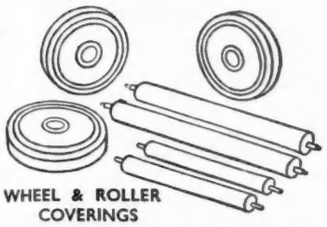

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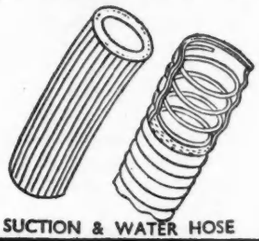

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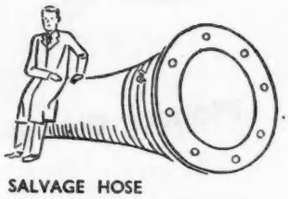

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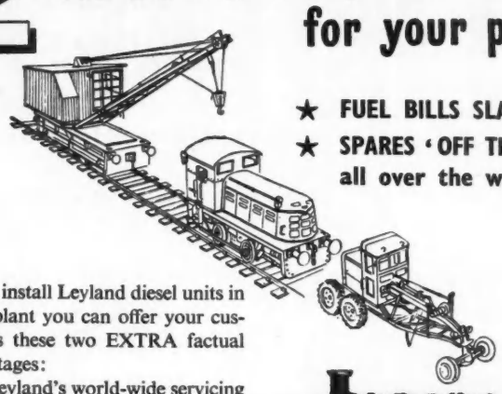

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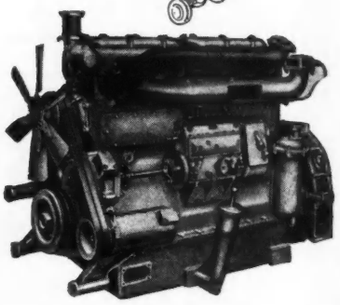

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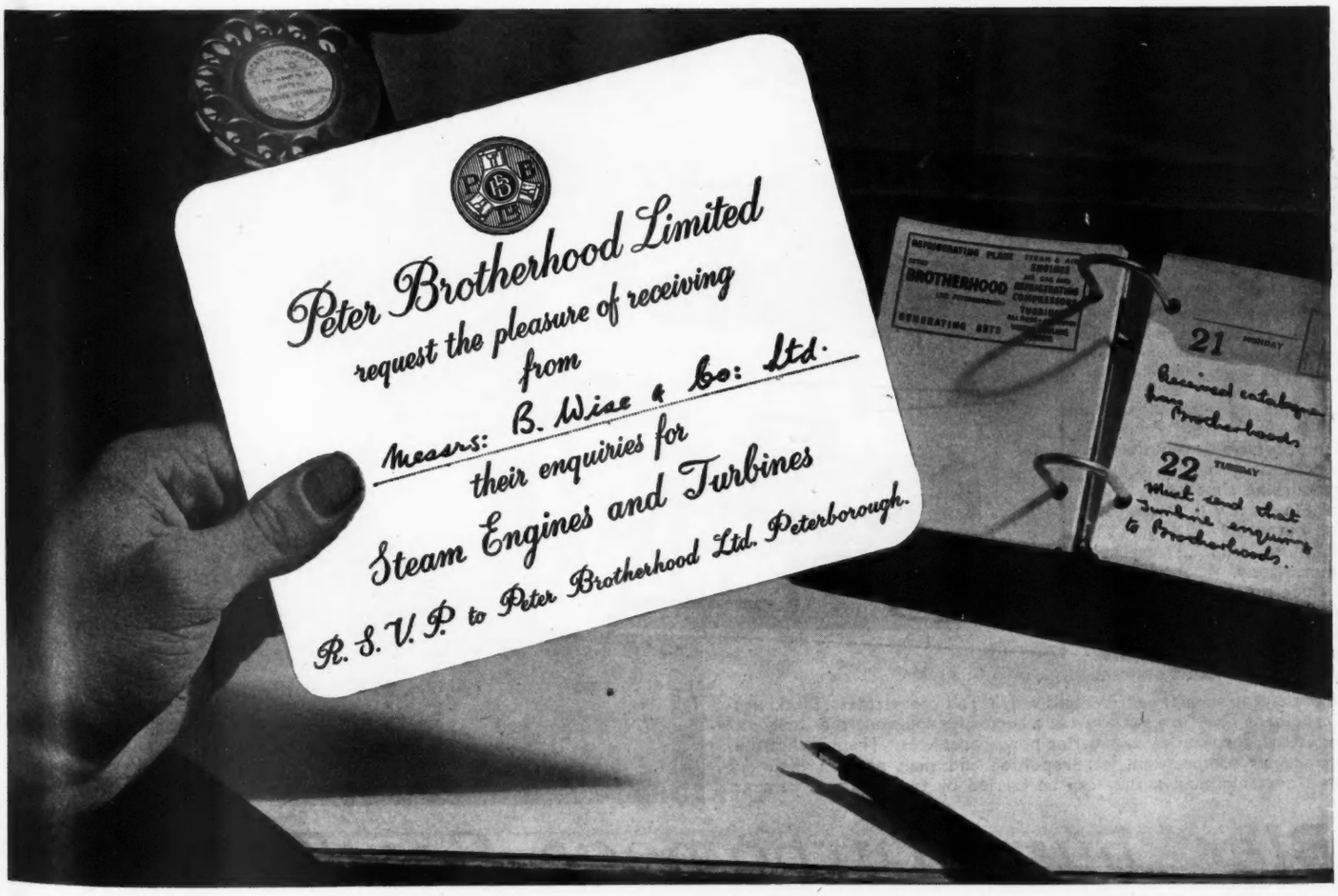

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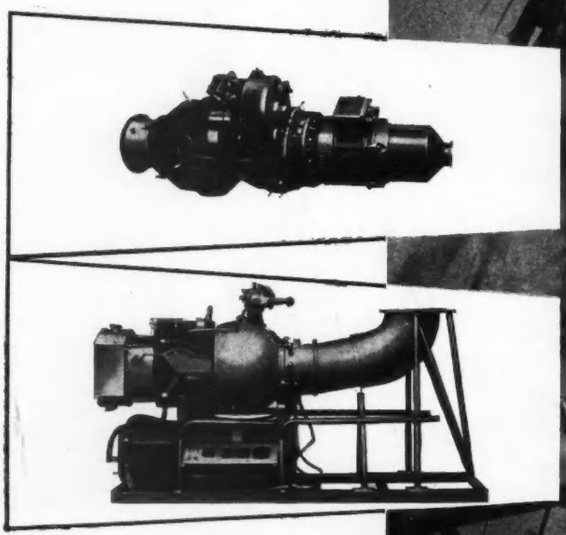

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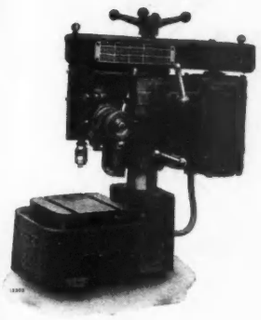

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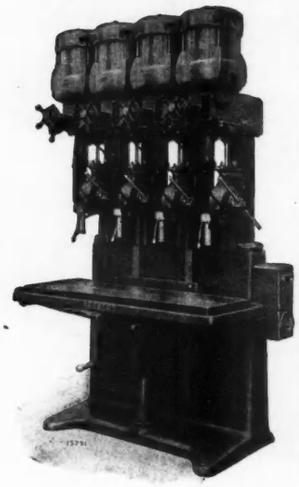

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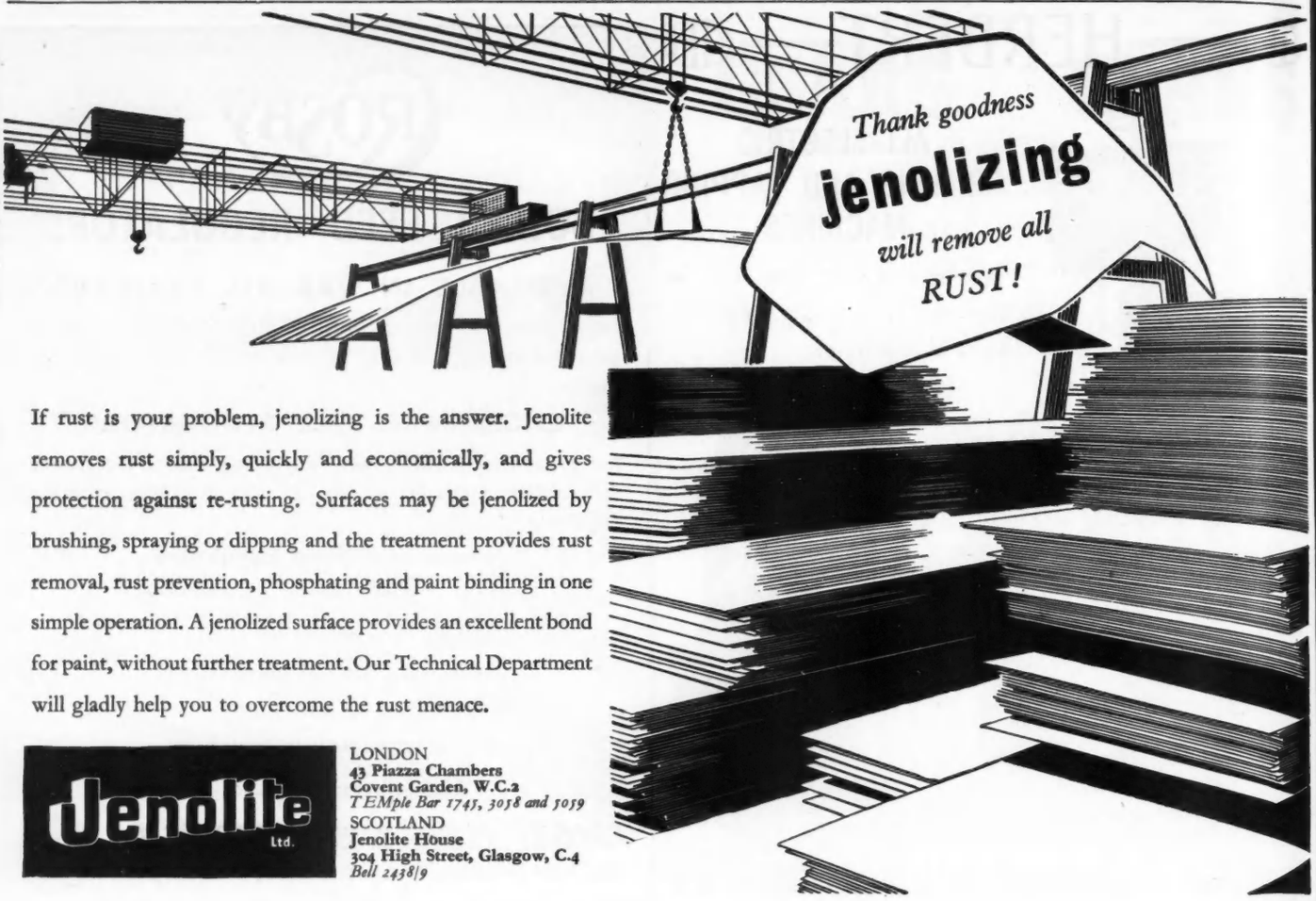

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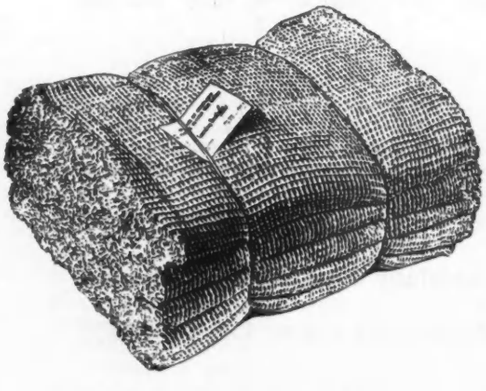

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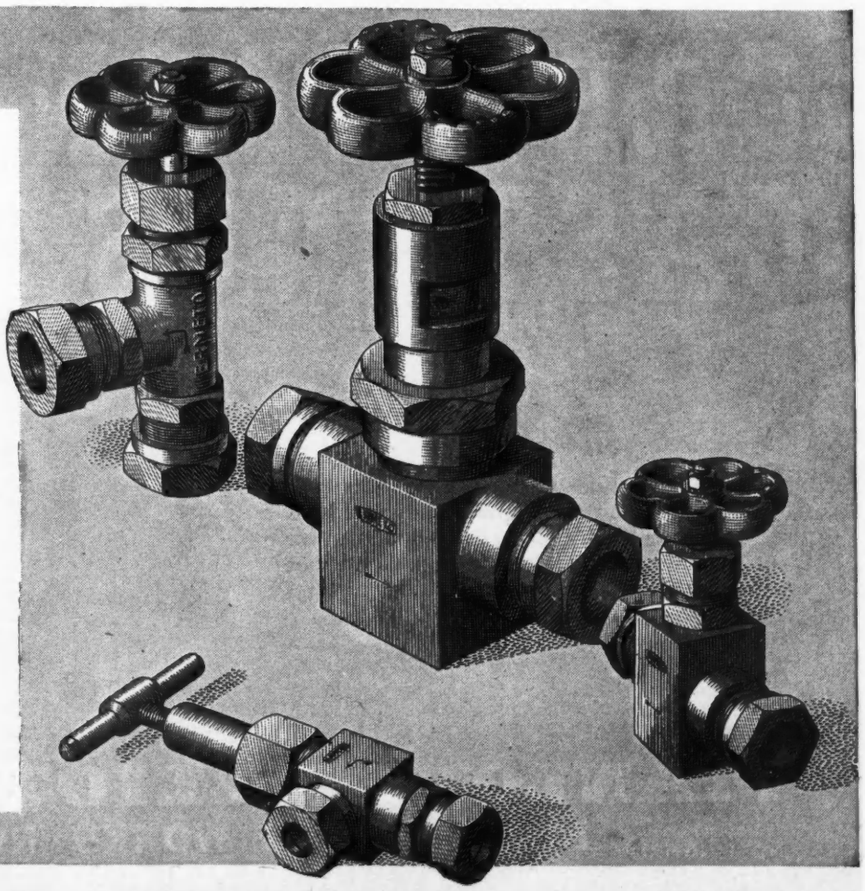

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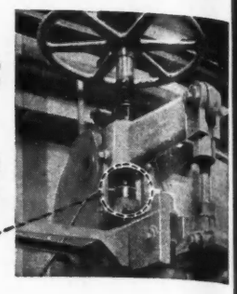

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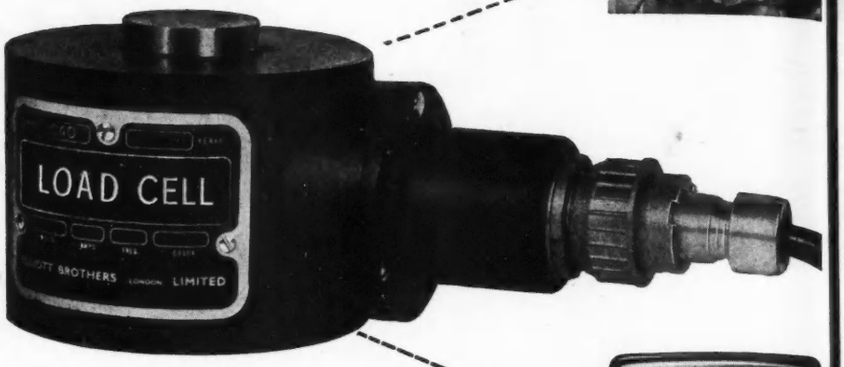

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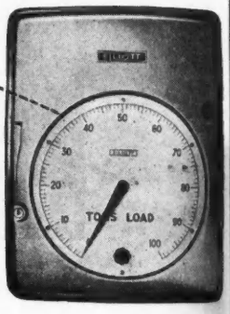

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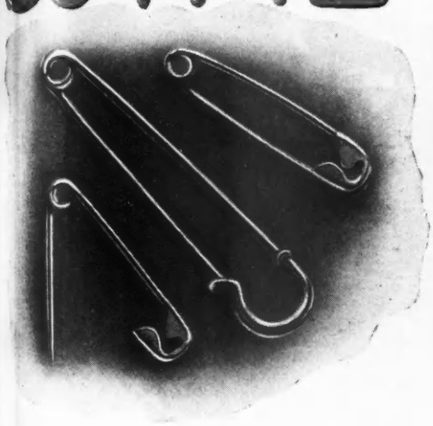

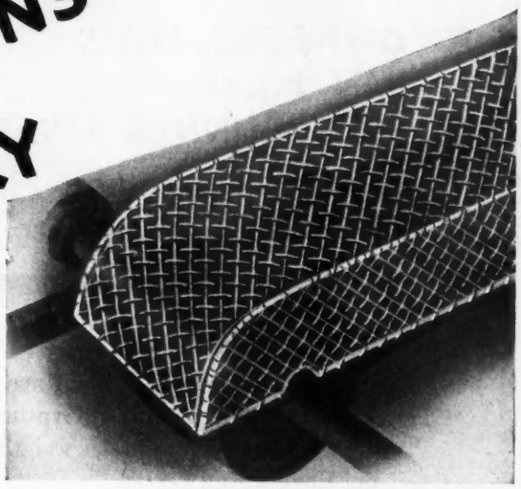

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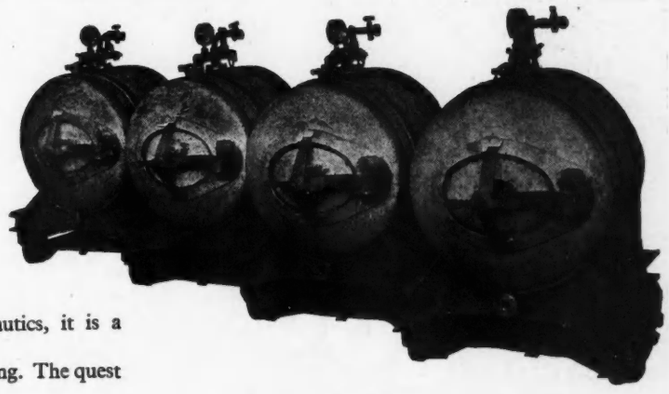

IF this is a "jet age" in aeronautics, it is a "stainless steel age" in manufacturing. The quest for cleanliness in manufacture and purity in processing extends far beyond foodstuffs. Anything that is processed or refined *must* be as pure as possible—and stainless steel is the hand-maiden of processing. In the fabrication of stainless steel plant and equipment, the Butterfield Organisation is well known. Its output is large, quality of the best. Interpreting specifications, producing finely finished equipment, Butterfield engineers are doing splendid work for the food processing, chemical, dairy, brewing and textile industries.

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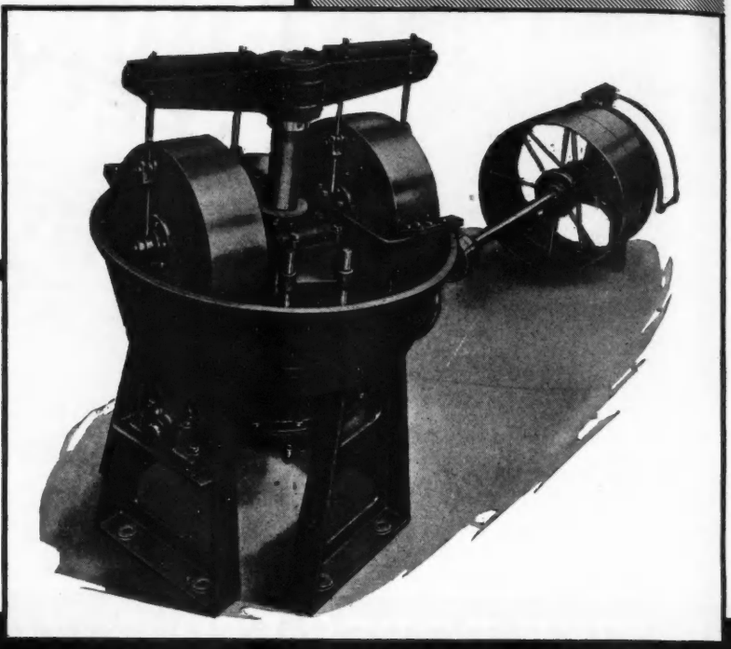
for grinding and mixing Mortar, Sand, Ores, Minerals, etc.



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Impregnating Plants, Calciners, Rotary Dryers, Mixers and Blenders, Gypsum Plant, Castings up to 5 tons in weight, General Engineering Plant.
Equipment manufactured to customers' drawings and specifications.

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PRATCHITT BROS LIMITED CARLISLE

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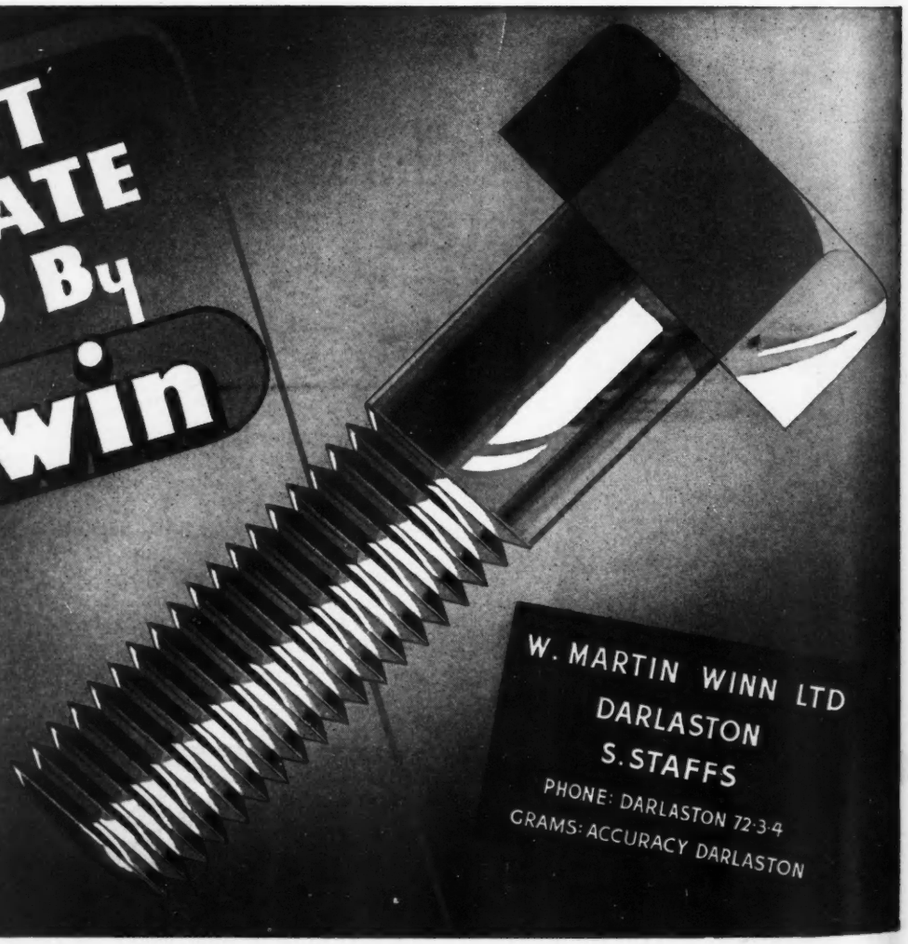
PR2

BRIGHT ACCURATE BOLTS By Marwin



Marwin Bolts and Set Screws are noted for their bright, 'clean' looks. They are also famous for their accuracy. Available up to 3 in. diameter—larger if required. Send for catalogue.

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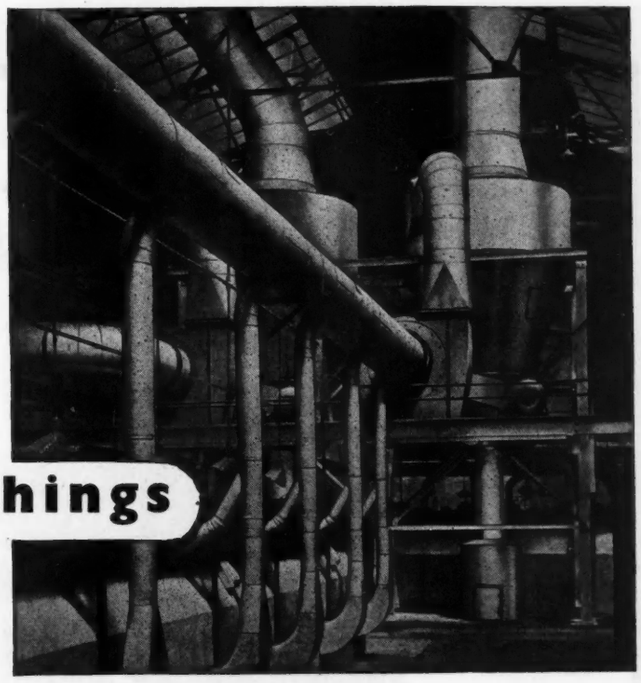
making the best of things



KEITH BLACKMAN have been making the best of fan engineering equipment since 1883. Production, research, design and development facilities—some of the best in the world—at the factory and foundries in London and Arbroath, have won and now maintain a reputation for sheer ability when it comes to the big jobs—the special jobs—the hard-to-handle jobs. If you are concerned with the movement or treatment of air or gases, send now for Publication No. 20/2—*it will give you a good idea of the extent of our range of both special and standard equipment.*

Installation for the removal of dust from polishing mops, using "TORNADO" No. 22 "P" type fans, and 8' 0" diameter cyclones.

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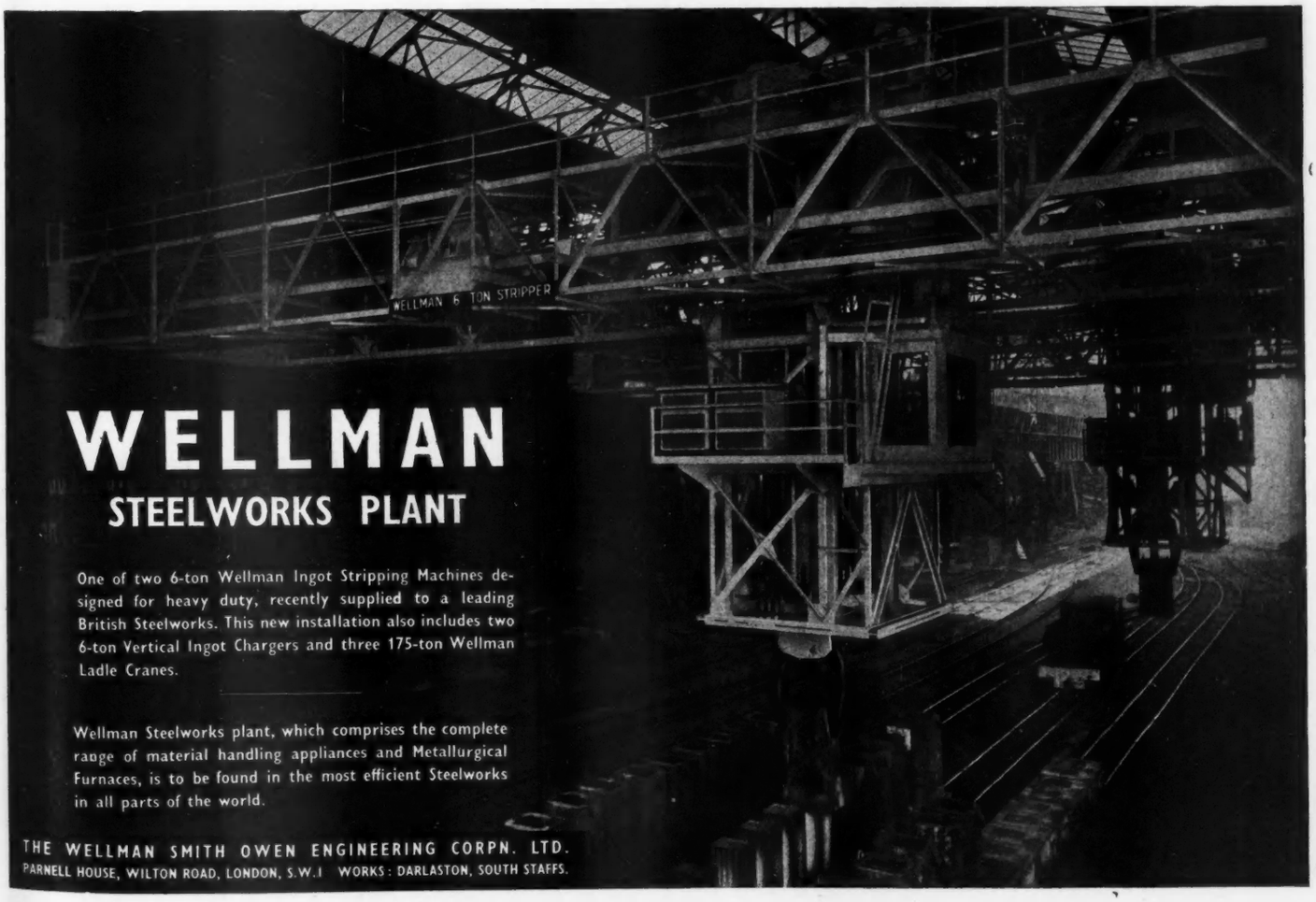

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STEELWORKS PLANT

One of two 6-ton Wellman Ingot Stripping Machines designed for heavy duty, recently supplied to a leading British Steelworks. This new installation also includes two 6-ton Vertical Ingot Chargers and three 175-ton Wellman Ladle Cranes.

Wellman Steelworks plant, which comprises the complete range of material handling appliances and Metallurgical Furnaces, is to be found in the most efficient Steelworks in all parts of the world.

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KORDEK

means service to foundries

THE NAME KORDEK is known throughout the foundry industry. Kordek and Kordol were the first cereal binders ever offered to the industry, and modern cereal-binder practice, with its many great advantages for most classes of foundry work, was built up around them.

Today, the makers of the Kordek and Kordol range are still pioneering the development of new uses for cereal binders. An example is the use of G.B. Kordek together with synthetic resins, to supply the green bond that the resins lack.

The binders in the Kordek and Kordol range have been widely imitated, but they are still, by a large margin, the most widely used of all cereal binders. Naturally, foundrymen prefer to buy their cereal binders from the firm with the widest experience and the largest resources—the firm that performs and controls every manufacturing operation from the grain to the finished product. And the foundrymen are wise, for beside this reassuring background of experience, resources, and control, the Kordek and Kordol range is backed by a service of technical advice which no other manufacturer of cereal binders can equal.

KORDEK
BINDERS
KORDEK G.B. KORDEK G.B. KORDOL

G. B. KORDEK and G. B. KORDOL are Manufactured under British Letters Patent Nos. 515470 & 543202

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B&P

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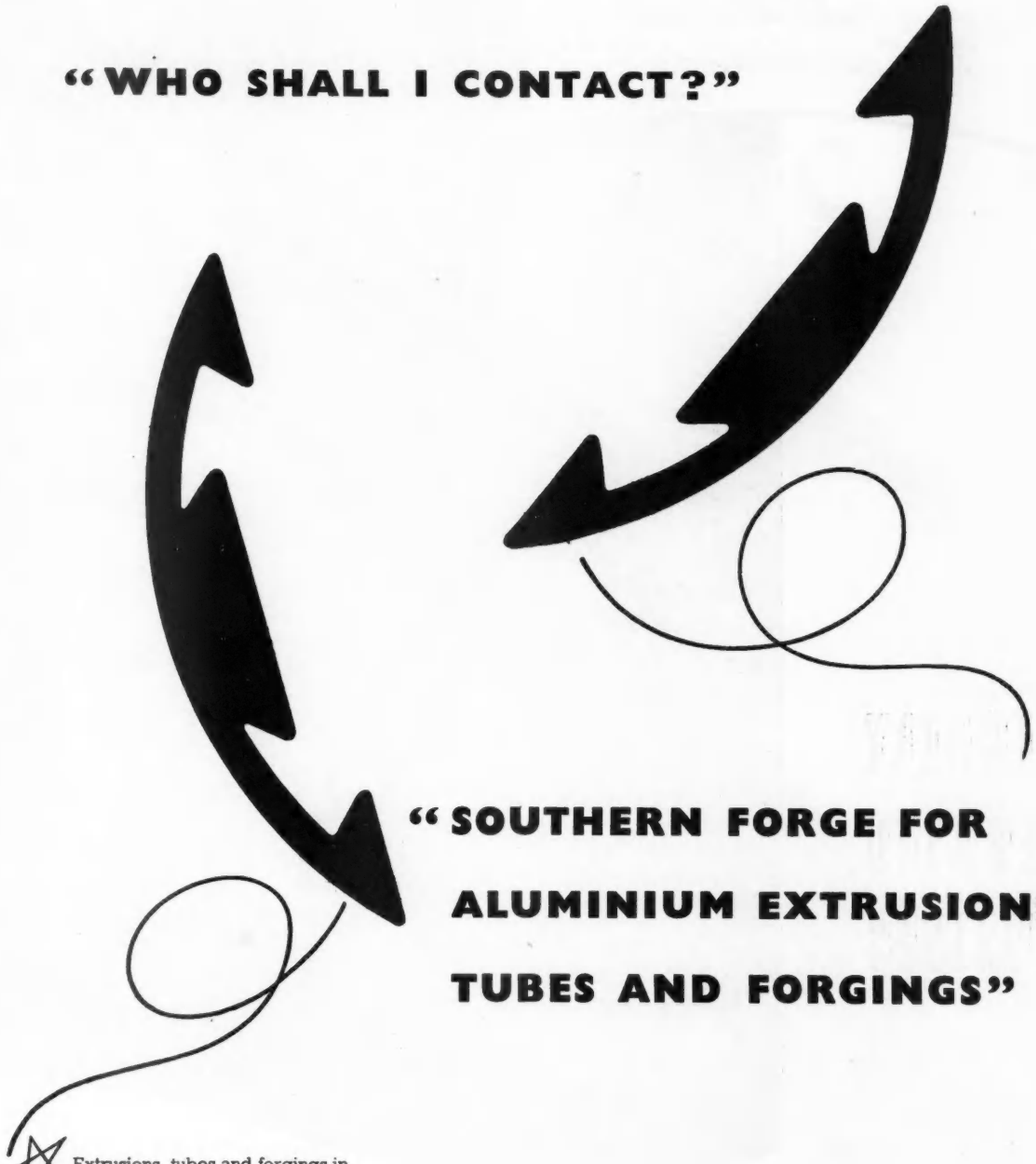
CORN PRODUCTS CO. LTD., WELLINGTON HOUSE, 125-130 STRAND, LONDON, W.C.2

"WHO SHALL I CONTACT?"



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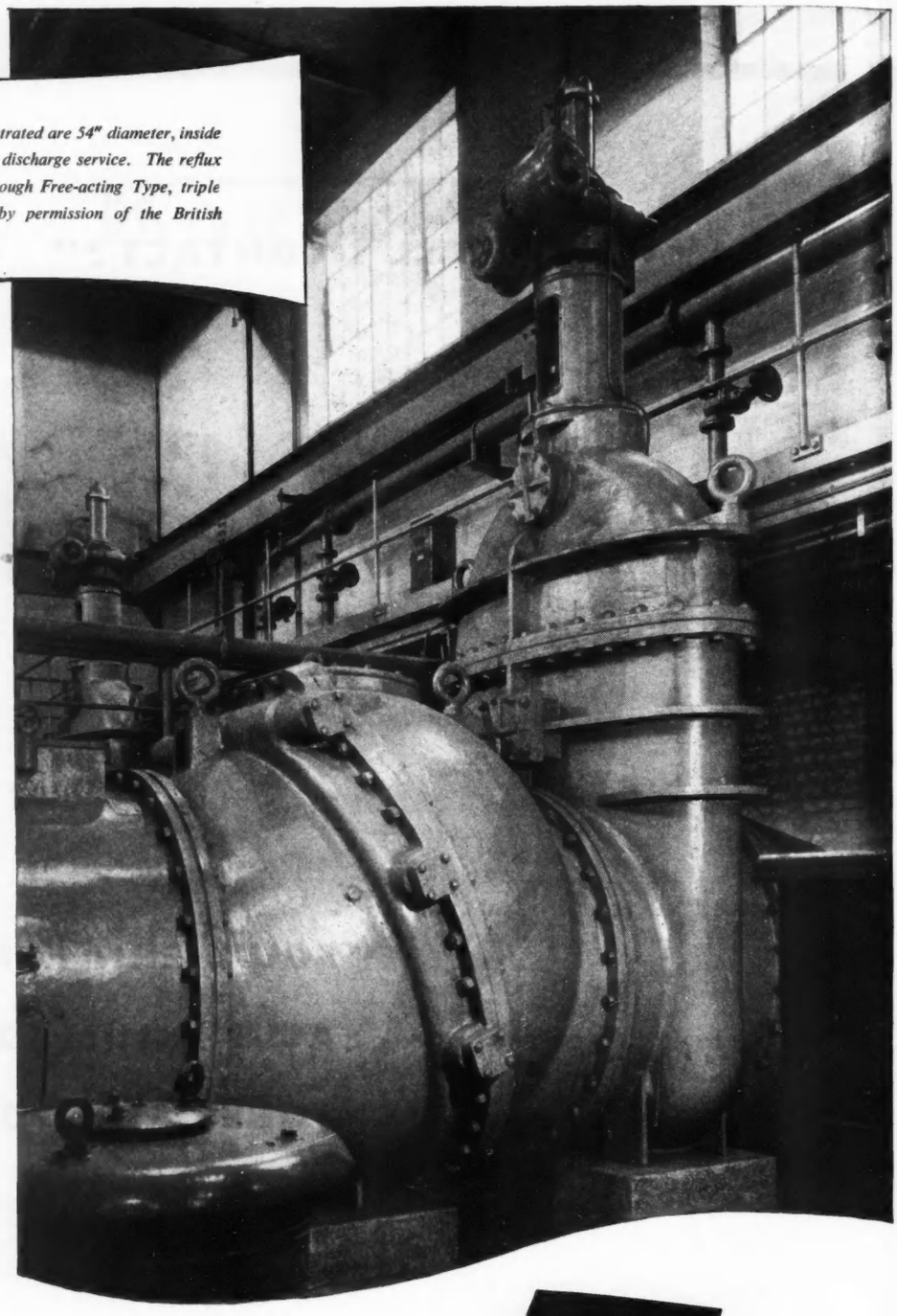
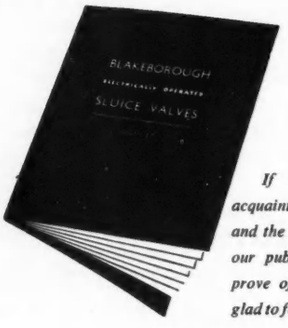
ALUMINIUM AND ALUMINIUM ALLOY EXTRUSIONS, TUBES AND FORGINGS



The sluice valves illustrated are 54" diameter, inside screw pattern, on pump discharge service. The reflux valves are of Blakeborough Free-acting Type, triple door version. (Photo by permission of the British Electricity Authority.)

ELECTRICALLY OPERATED SLUICE VALVES

The success of the Blakeborough Electrically Operated Sluice Valve lies in its thoroughly considered design, and the attainment of that *extra* reliability which allows full advantage to be derived from the use of electric power and controls. Backed by many years of practical experience in all details of application, the latest Blakeborough designs provide what is widely accepted as the best proposition on the market. A claim that is confirmed by the large numbers now installed thoughout the world.



If you are not already acquainted with the range of types and the possibilities of their use, our publication No. 197 should prove of interest. We shall be glad to forward copies on request.

J. BLAKEBOROUGH & SONS LTD

BRIGHOUSE, ENGLAND

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The photograph shows about one-sixth of the whole layout. Each item was despatched completely fitted for laying in the track at Bombay.

Five times the life for three times the cost, to say nothing of 24 years without renewal!

There is no question about it!—during 1927/1928 Edgar Allen supplied to the Great Indian Peninsular Railway for Victoria Terminus Station, Bombay, a complex switch and crossing layout in Imperial Manganese Steel. If made in ordinary rail steel, at one-third the cost, the life would have been 4/5 years; in manganese steel the life has been 24 years, and the Indian Government Railways decided to renew the whole, exactly as before.

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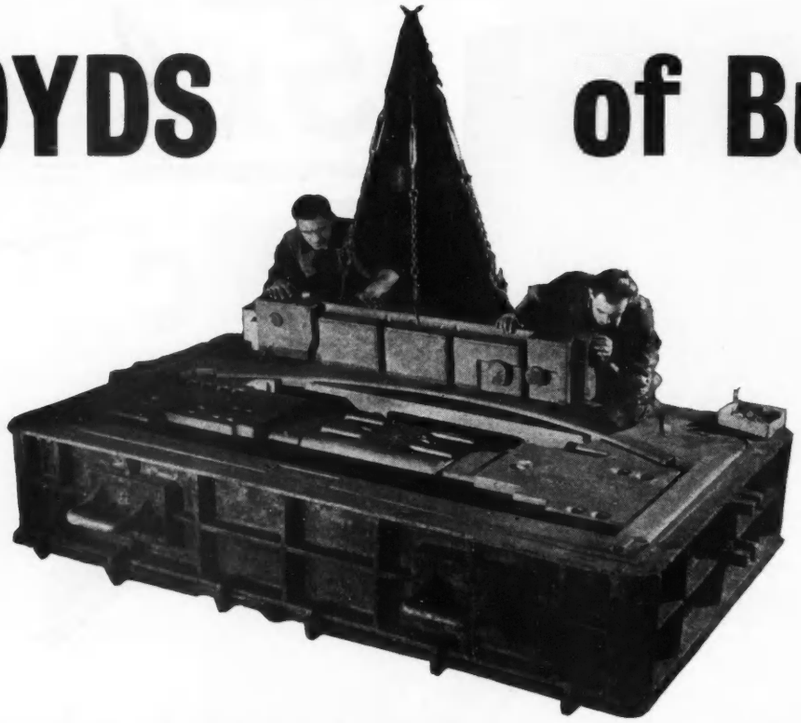
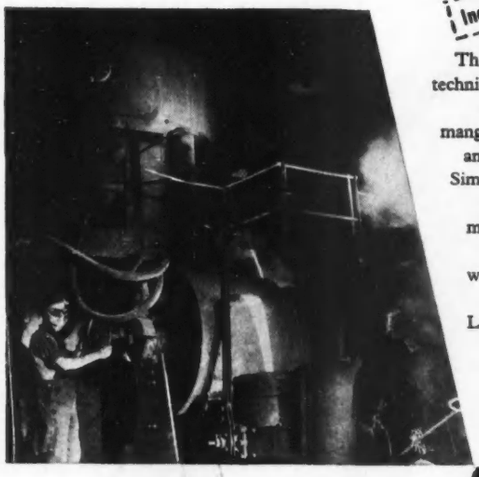
LLOYDS of Burton



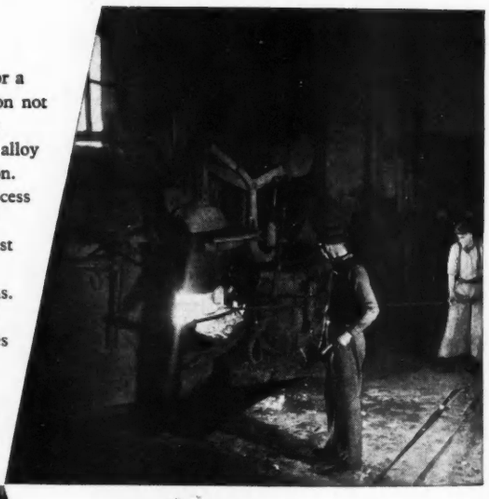
Including Ductile Iron.

are casting Alloy Steels and High Duty Irons

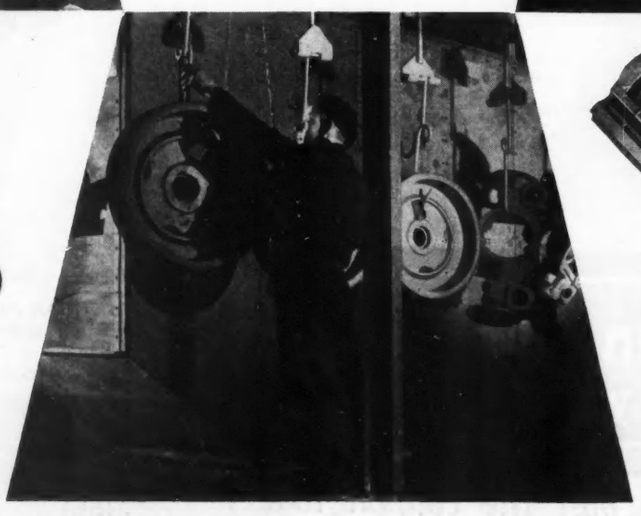
Including Manganese Steel



The successful casting of Manganese Steel calls for a technical knowledge and degree of practical application not commonly found in the foundry field. Yet manganese steel is only one of the wide range of alloy and carbon steels that are cast by Lloyds of Burton. Similarly, the making of Ductile Iron is a process demanding the strictest and most experienced metallurgical and melting control, but Lloyds cast Ductile Iron with the skill and sureness with which they cast a wide range of High Duty Irons. Complete quality control of every process gives Lloyds castings a uniform structure, which ensures easy machining, exceptional durability and optimum efficiency. Whatever your requirements in the Ferrous foundry field consult Lloyds of Burton before you order.



Manganese Steel Centurion Tank Track Links approximate weight of each link 38 lbs.



Ductile Iron Slide Casting for Machine Tools approximate weight 200 lbs.

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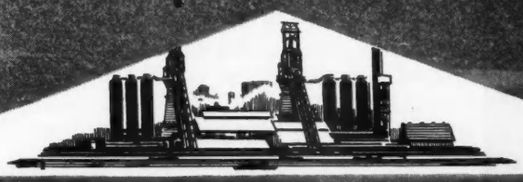
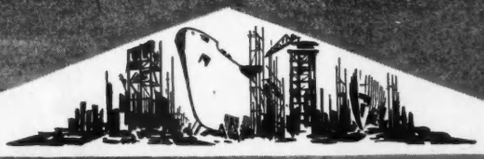


STEELWORKS PLANT



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TUBE TESTING MACHINES
ROLL FORMING MACHINES FOR SECTIONS

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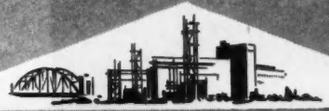

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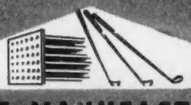

TUBE MANUFACTURE

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B 100

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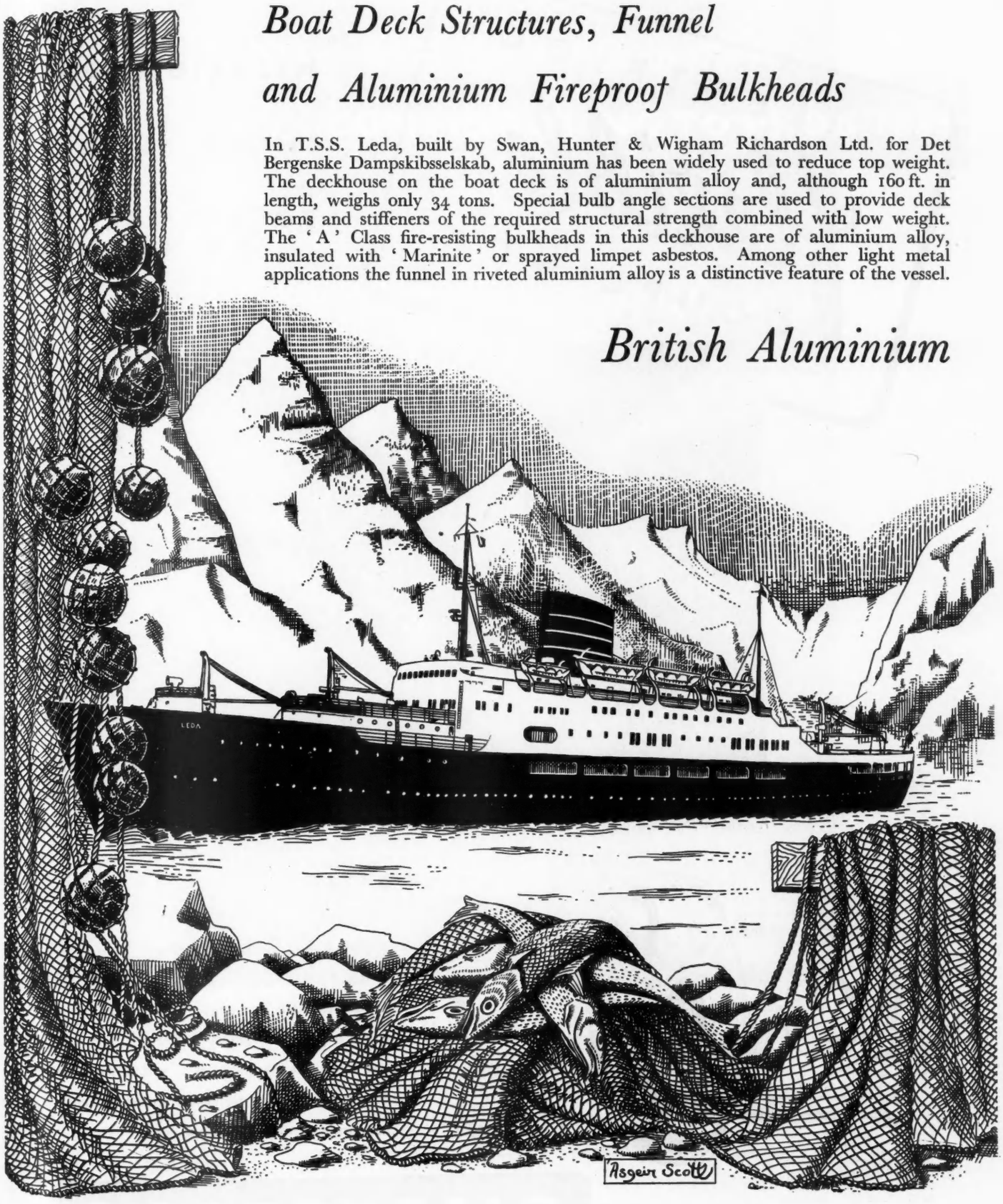
British Aluminium



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flexible

COUPLINGS

FOR CORRECTING
MISALIGNMENT
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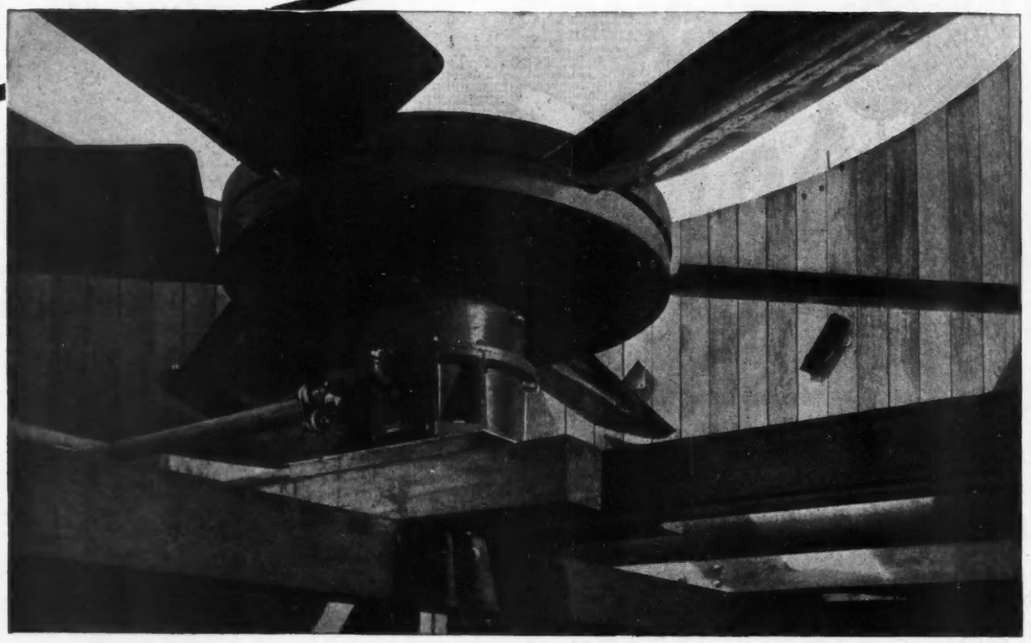
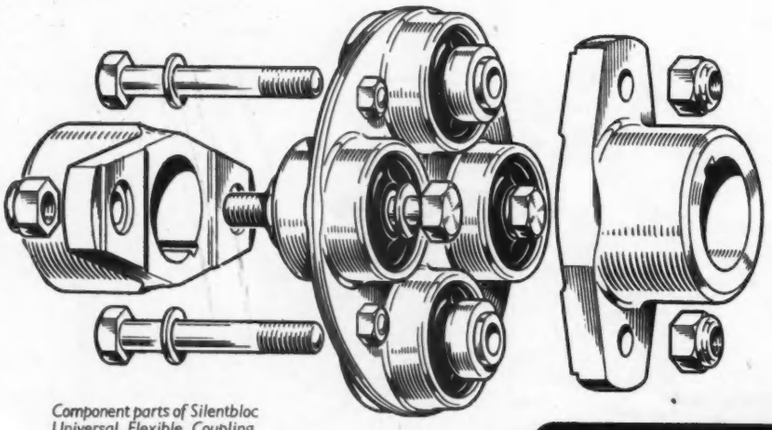


Silentbloc Flexible Coupling in the fan drive on a prefabricated "Counterflo" Cooling Tower as manufactured in Great Britain by Head Wrightson Processes Ltd., in association with the Fluor Corporation of Los Angeles.



Component parts of Silentbloc Universal Flexible Coupling. Sizes to transmit from 0.15 to 20 h.p. at 100 r.p.m. are available. Covers can be provided.

● Silentbloc Universal Couplings are particularly suitable for use in exposed conditions. They need no lubrication and no protection from water, grit or dirt. A single coupling accommodates angular misalignment of 5 degrees while two units provide for all but abnormal parallel misalignment. There is no metallic wear as all relative movement is within the rubber bearings which reduce torsional vibration and absorb shock loads. Particulars on application.

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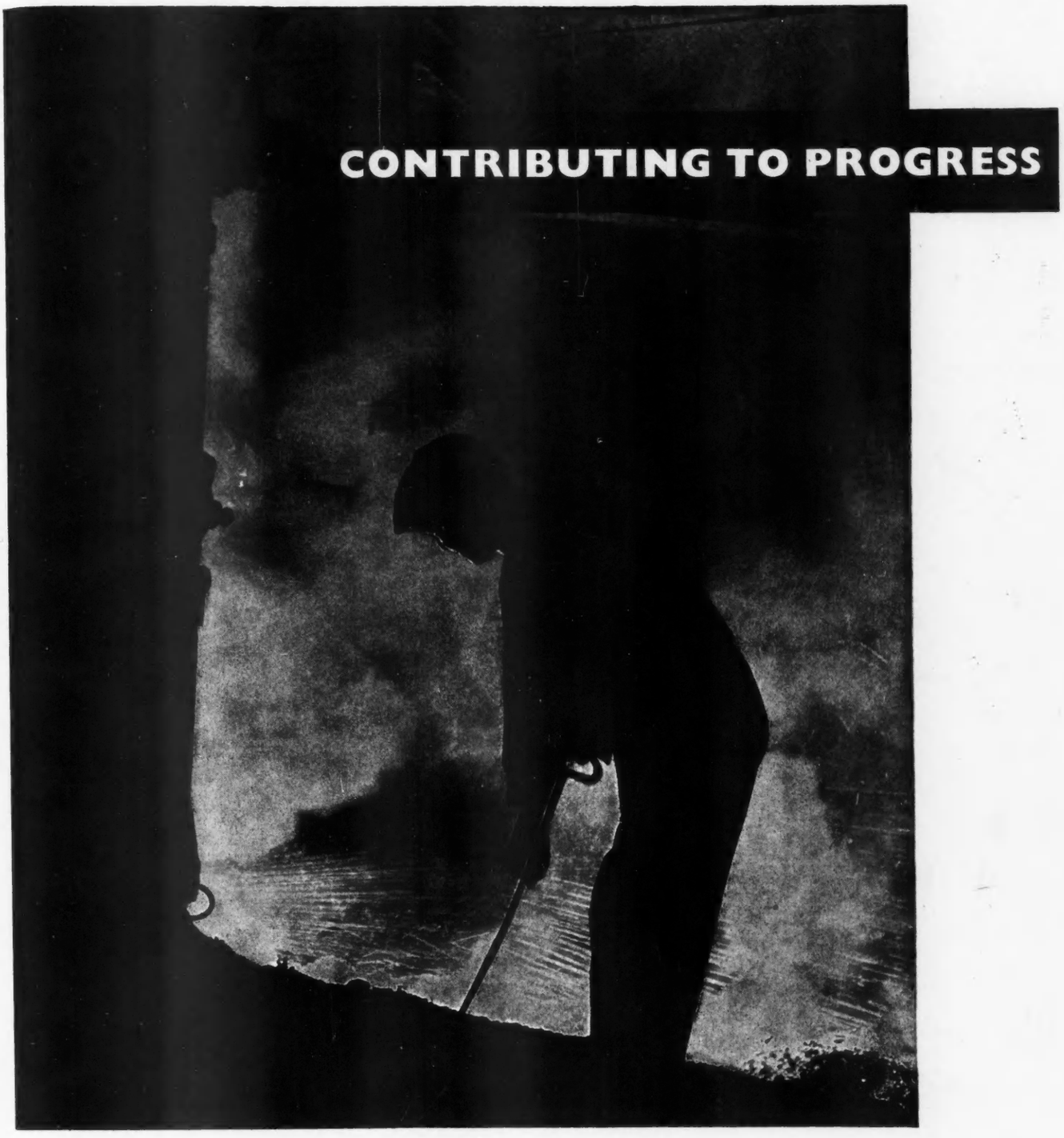

Furnaceman at blast-furnace tap-hole ready to clear any obstruction in the runner

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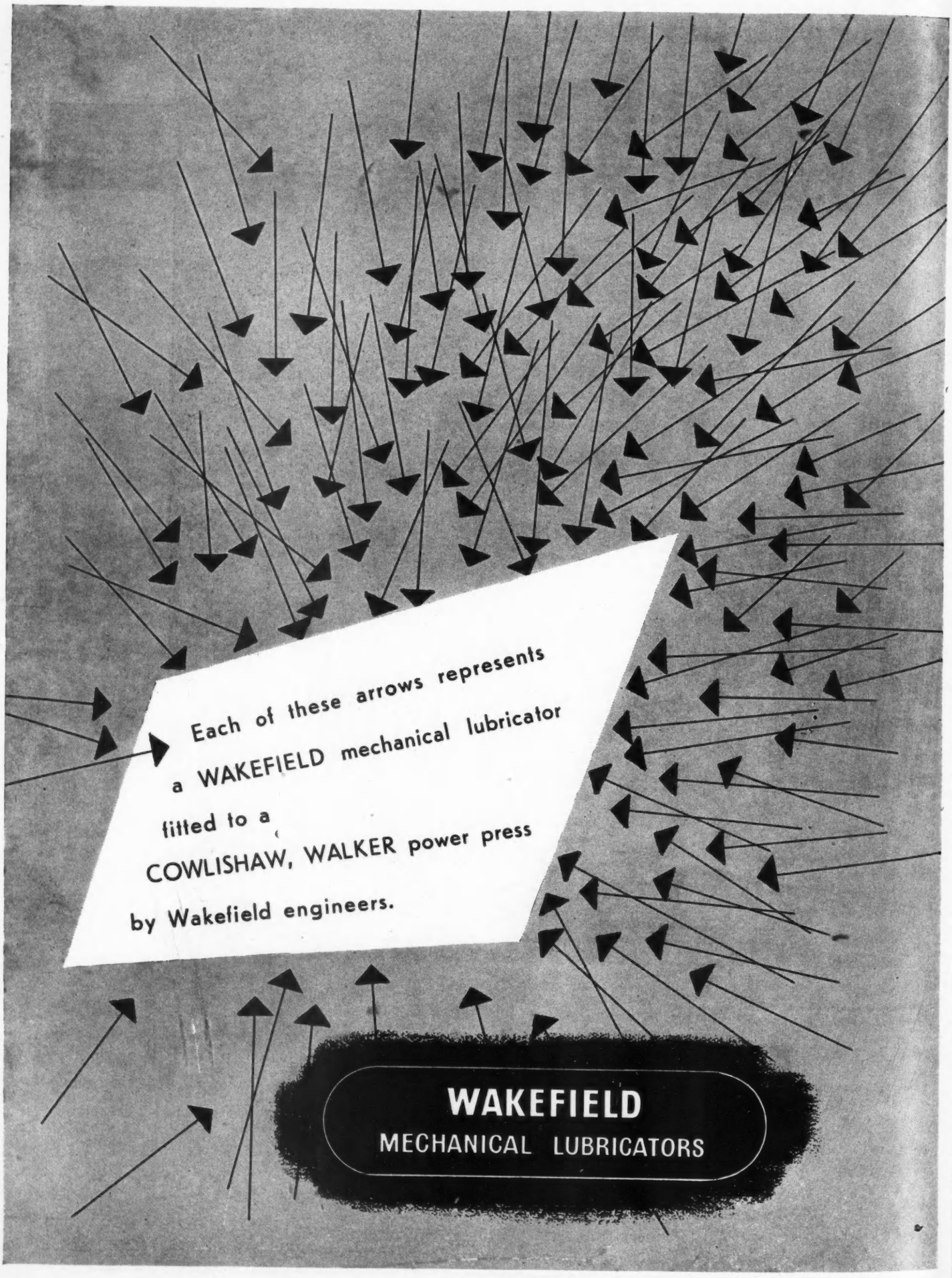
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fitted to a
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by Wakefield engineers.
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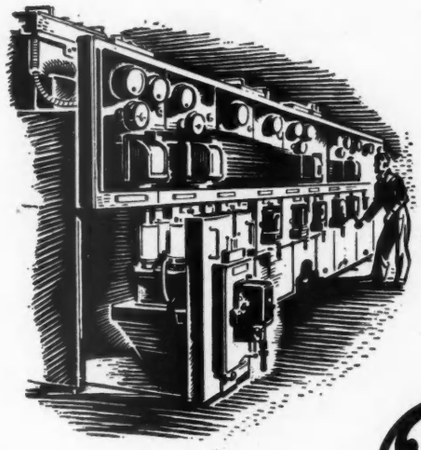

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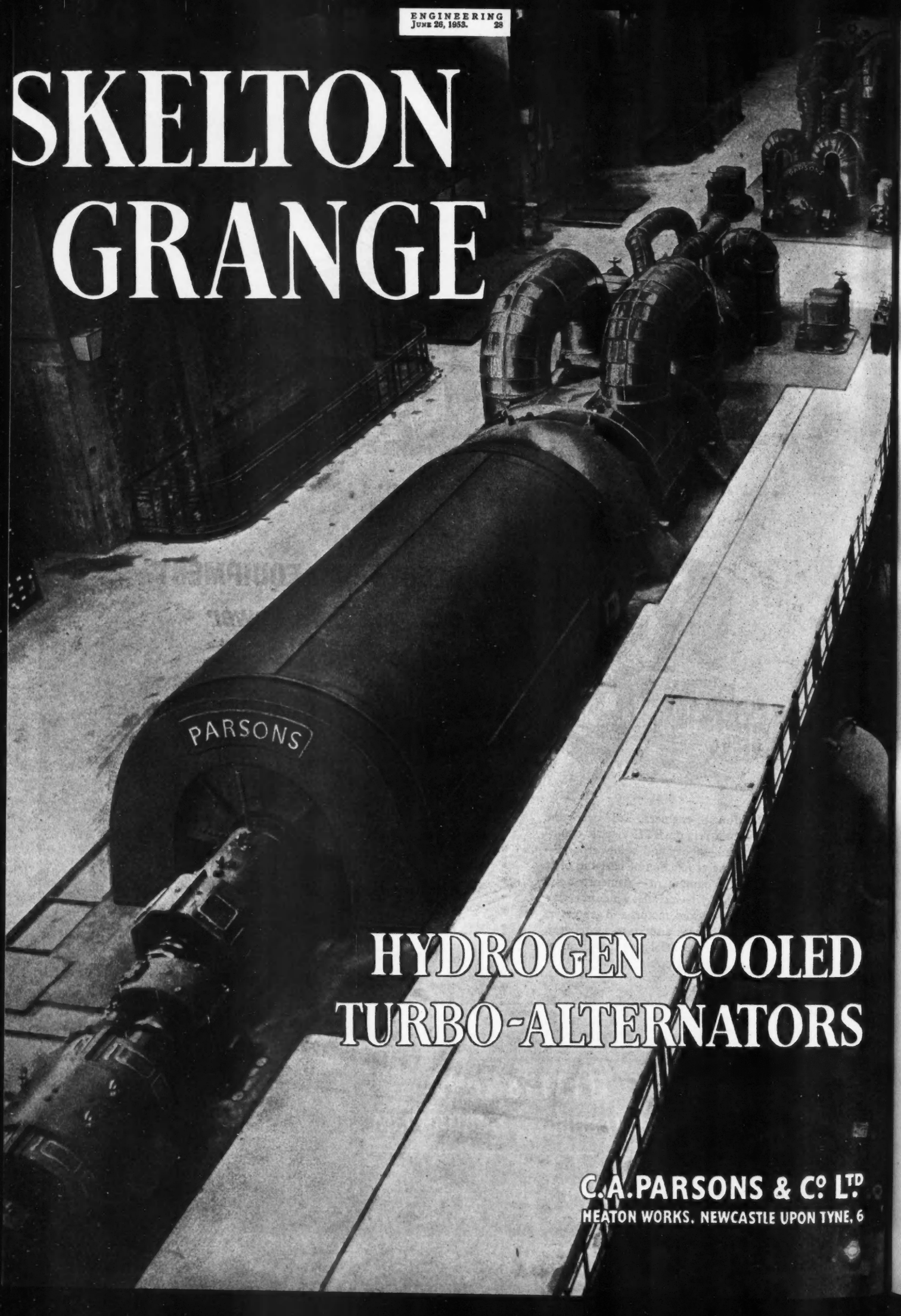

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C.A. PARSONS & Co LTD
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CRANE PACKING LIMITED

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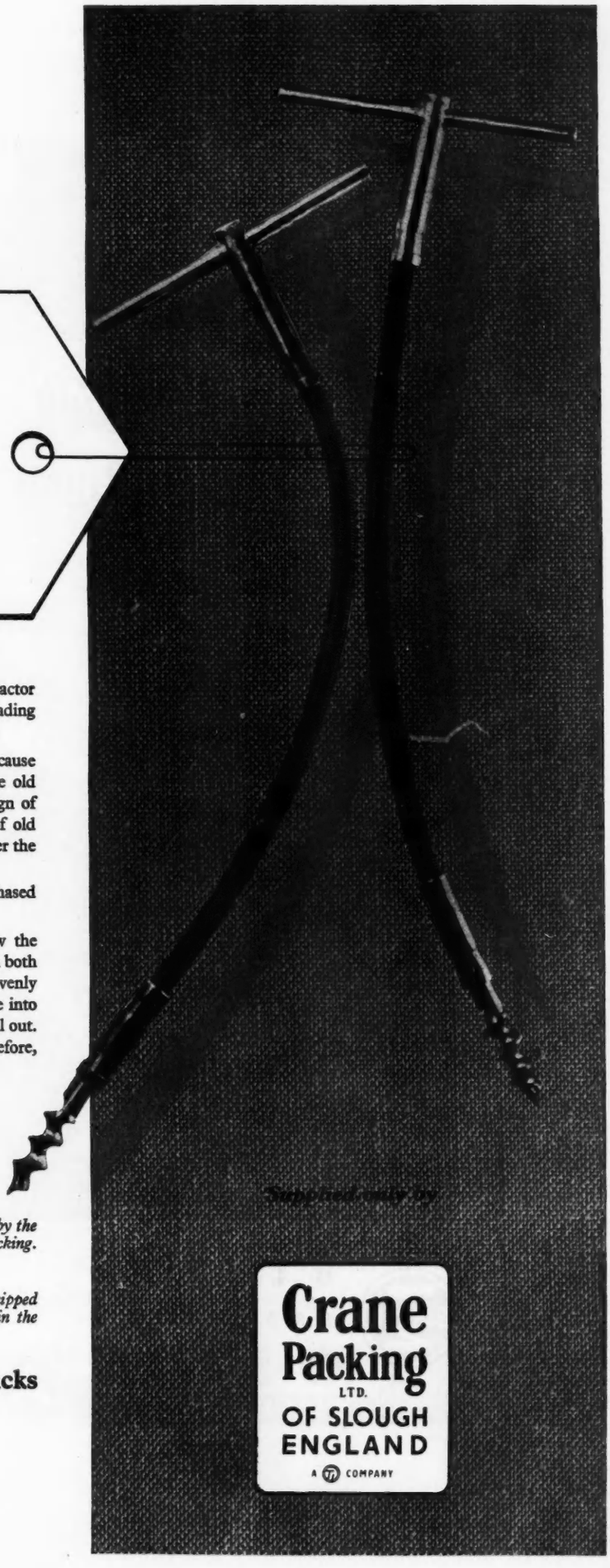


WHO are better qualified to design Gland Packing Extractor Tools than experienced technicians of one of the World's leading Specialist Manufacturers of Packings?

The life of a Gland Packing is often adversely affected because it is not fitted properly due, not infrequently, to vestiges of the old packing being left at the far end of the stuffing box. The design of these Extractor Tools has been evolved so that the removal of old worn packings is simplified. They are also designed so that neither the screw nor the flexible shaft is easily damaged (see below).

It is recommended that these Extractors should be purchased in pairs.

In order to remove an old worn packing, firmly screw the Extractors into it at opposite points and then by exerting a pull on both Extractor Tools simultaneously, the old packing will come away evenly and smoothly. The screw has a good point, sharp enough to bite into the hardest packing and it is specially shaped to grip and not fall out. Furthermore, the screw has a solid core and it will not, therefore, straighten out under pressure.

Other features of this design are:

1 *Where the screw will go, so will the rest of the shaft of the Extractor, without damaging the stuffing box or the shaft—**the diameter of the coupling does not exceed the diameter of the screw.***

2 *The inner and outer spirals of the flexible cable are wound in opposite directions and the cable is not damaged by the screwing action by which the screw is driven into the packing.*

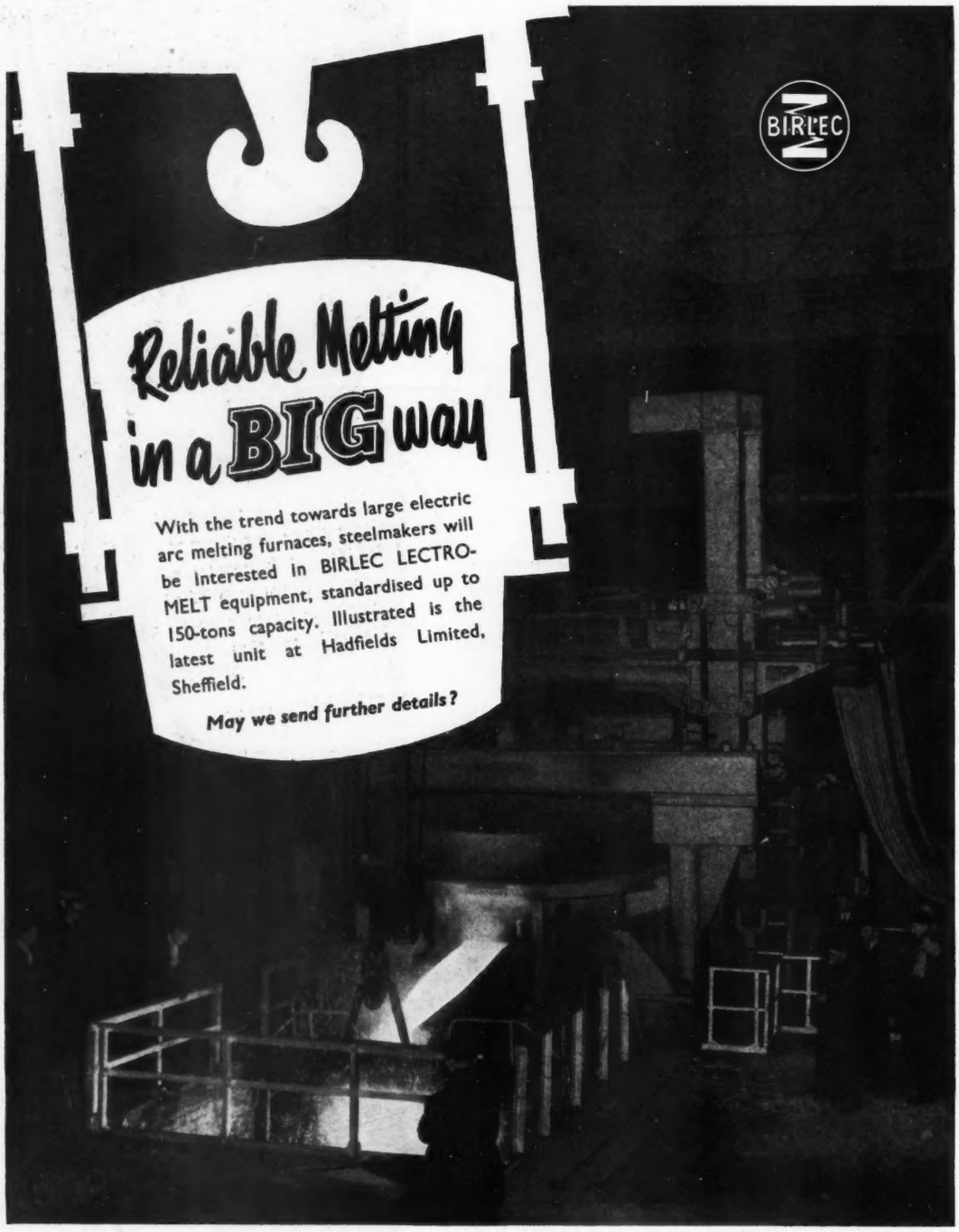
3 *The Extractors have a rust-proof finish.*

4 *For the removal of the lantern rings, the Extractors are equipped with a specially designed stud screw to suit tapped holes in the lantern ring.*

Crane Packing Limited, Slough, Bucks

Supplied only by

Crane Packing LTD. OF SLOUGH ENGLAND A 77 COMPANY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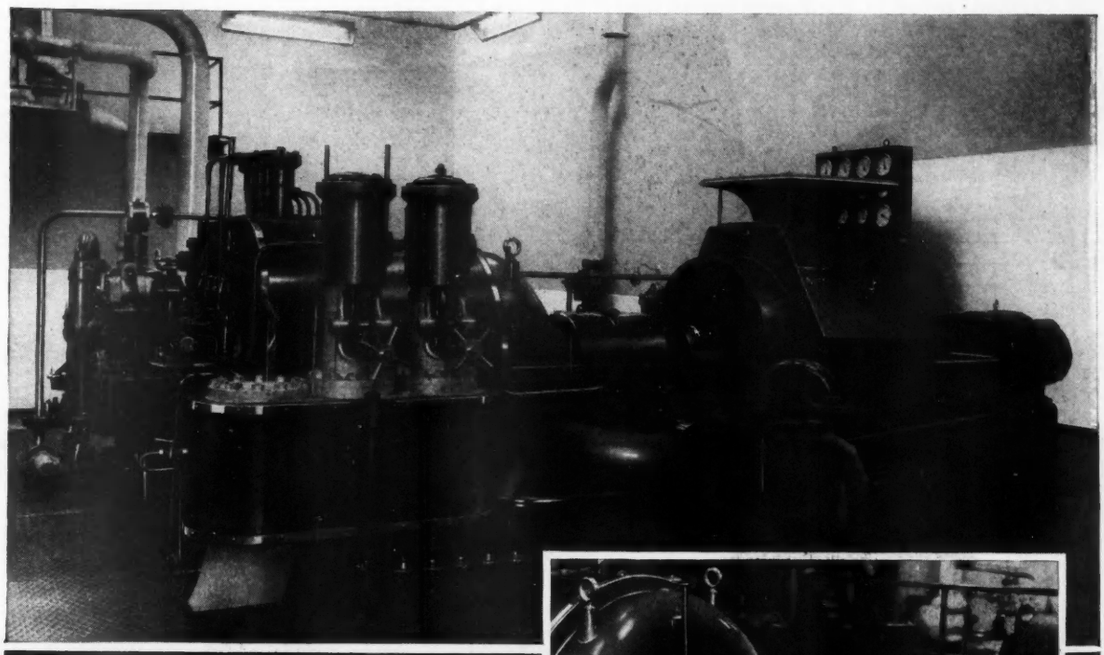

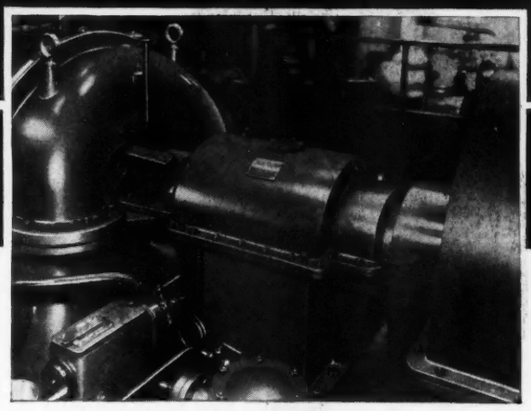

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TURBINE PLANT

supplying

Power and Process Steam for a large Textile Mill

The First British Industrial Turbo-alternator incorporating Epicyclic Gearing

THE turbo-alternator illustrated is the latest addition to the power plant at the Tiverton mill of John Heathcoat & Co., Ltd., who are one of the largest manufacturers of machine-made plain net and other textile fabrics. This 750-kW Allen pass-out set supplies most of the power and all the process steam requirements of the mill, and takes the place of two Allen turbo-alternators, a 250-kW set and a 400-kW set installed in 1926 and 1928 respectively, both of which are retained in full working order as standby machines and to meet the lower night-shift loads.

The steam conditions of the 750-kW set are:—195 p.s.i.g., 500° Fahr., 28½in. vacuum, and the quantity of process steam supplied is 20,000 lb. per hour at 30 p.s.i.g. The turbine runs at a speed of 7000 r.p.m., and the alternator at 1500 r.p.m., the speed reduction gearing being of the epicyclic type, a close up view of which is also illustrated. The turbine embodies the latest type of Allen leverless oil relay-operated speed and extraction-pressure governing, with automatic-nozzle control, and the unit is of special interest in that it is the first British industrial steam turbo-alternator which incorporates epicyclic gearing. This type of gearing is now being adopted in a wide range of power generating units and other applications in industry and on board ship.

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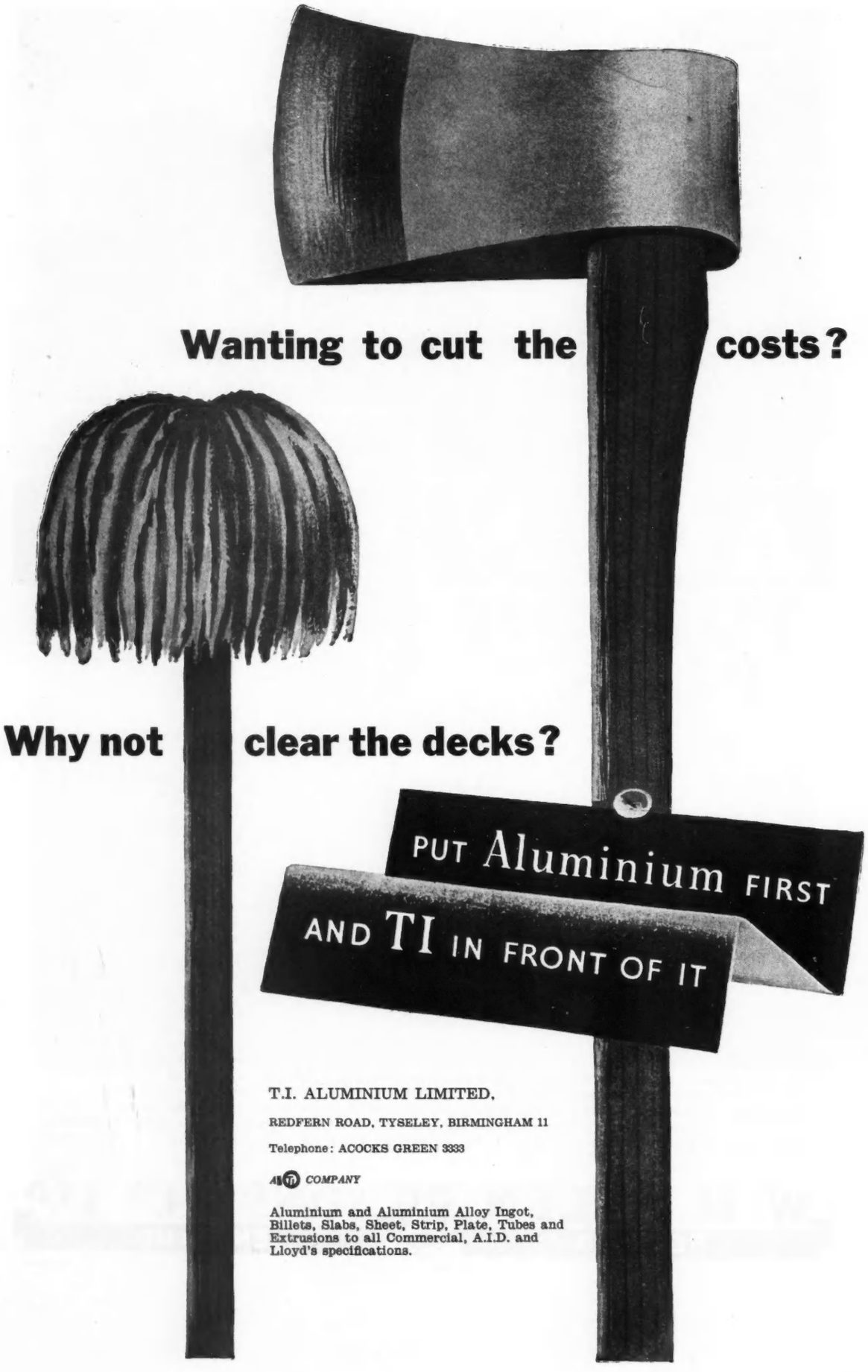

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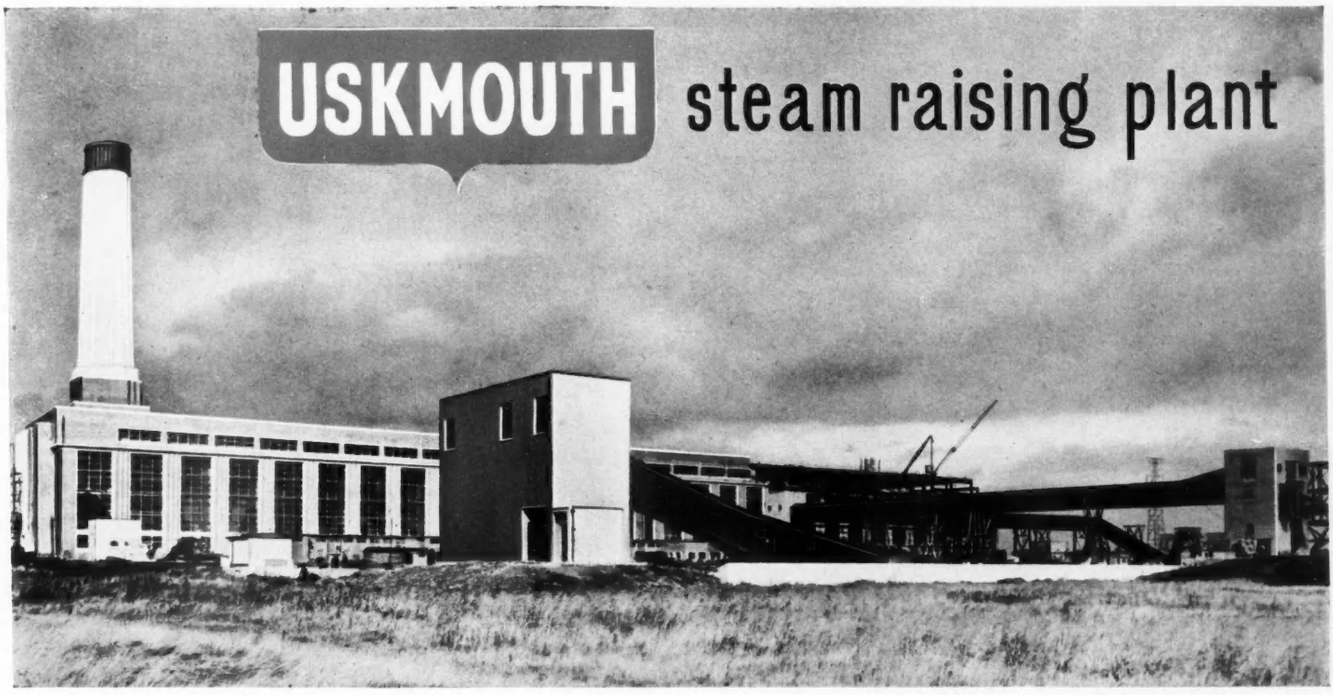
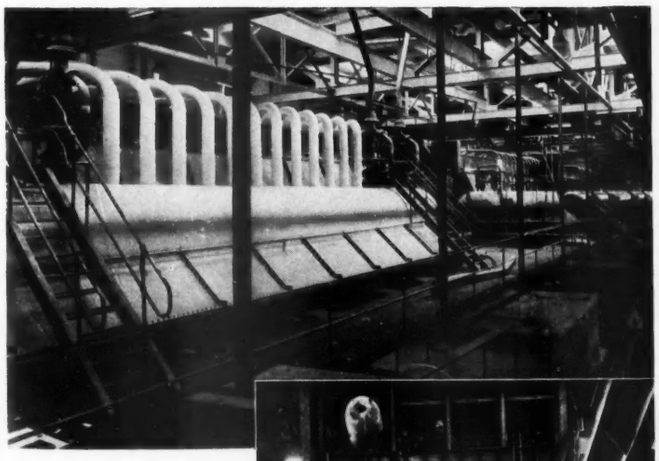
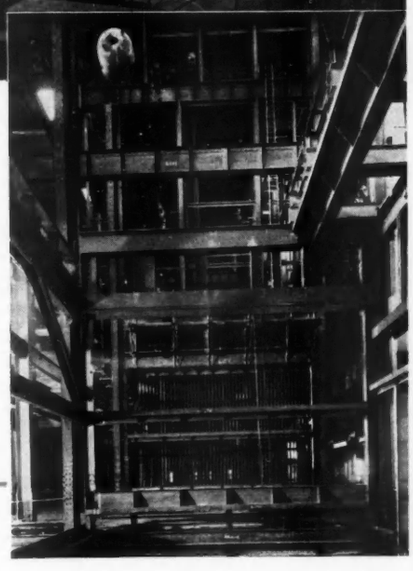


USKMOUTH steam raising plant

Uskmouth power station under construction, with part of the 600 tons/hr. coal conveyor system in the foreground.

BABCOCK contract throughout





The boilers during erection, and (above) view at drum level.

The steam-raising plant of the new 360 MW. USKMOUTH generating station is entirely BABCOCK. It comprises twelve p.f. fired High-head boilers, with a total capacity of 4,320,000 lb. of steam per hour (M.C.R.) at 950 lb./sq. in. and 925°F.

The contract with Babcock & Wilcox Ltd.—*largest single contract ever placed in Great Britain for steam-raising plant*—includes 36 type E coal pulverising mills, an impressive coal-handling installation to deal with 600 tons per hour, the extensive ash and dust disposal systems and overhead travelling cranes of capacities up to 175 tons.

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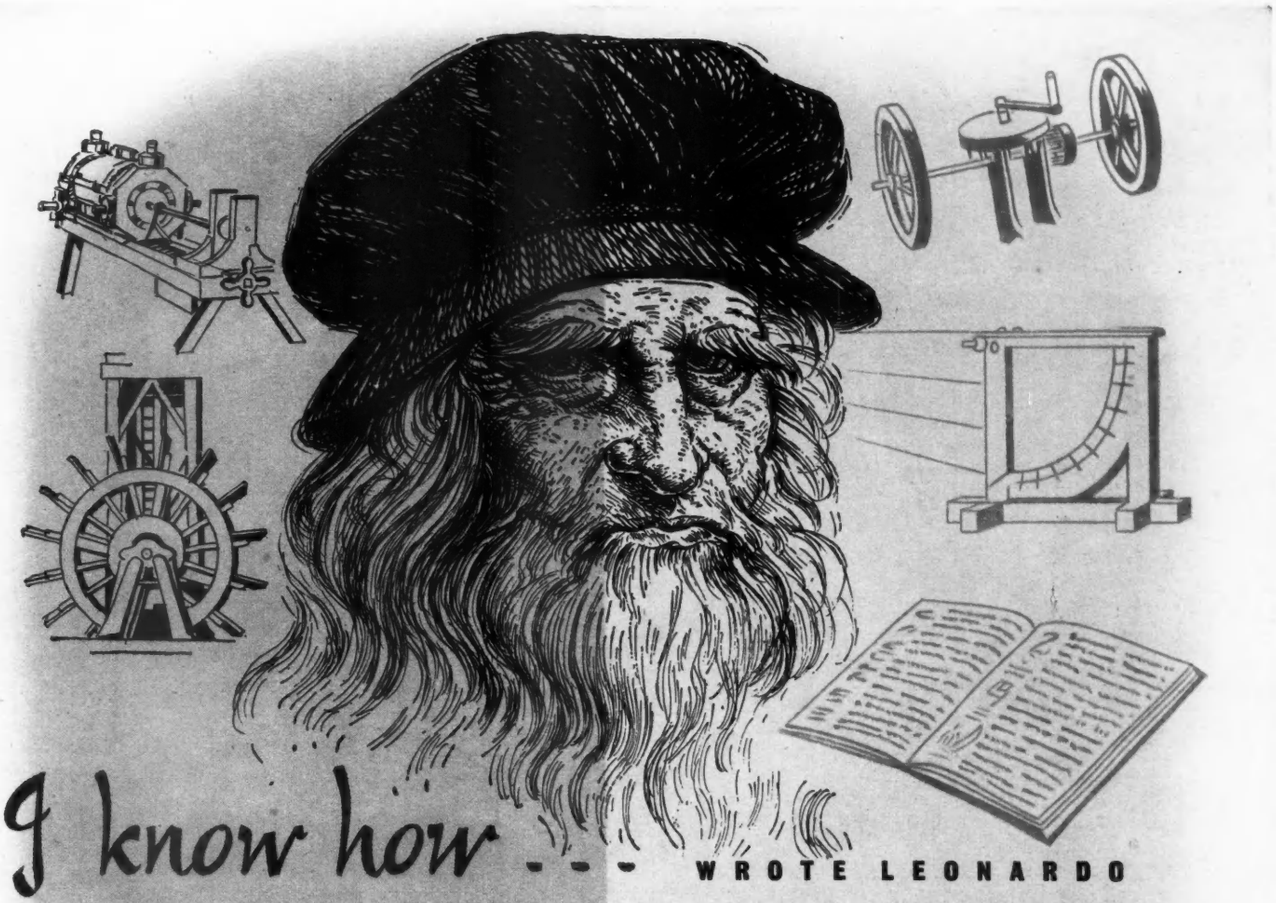

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. . . but theories are not sufficient. Realisation must depend upon the techniques of PRODUCTION.

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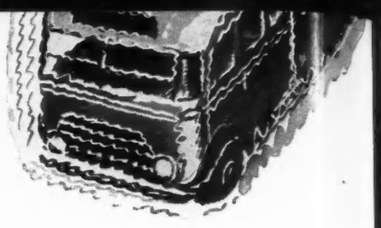
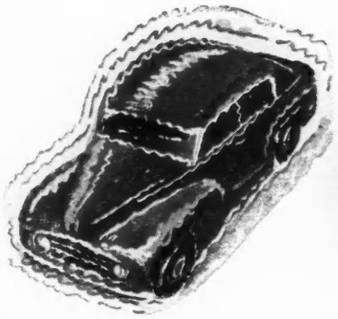
Andre stops vibration





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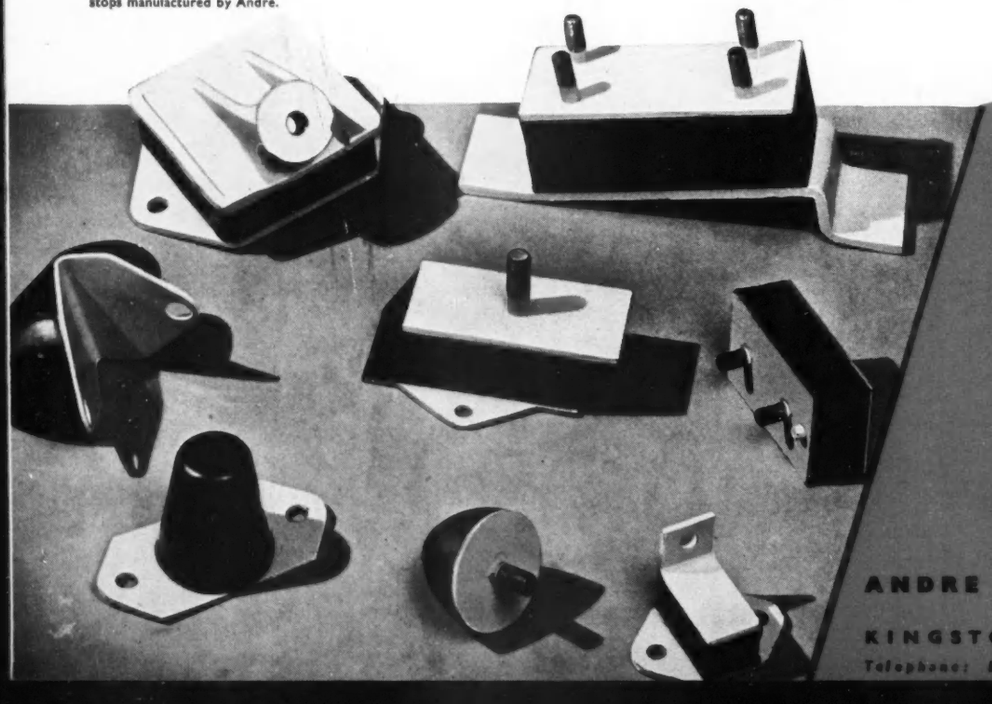

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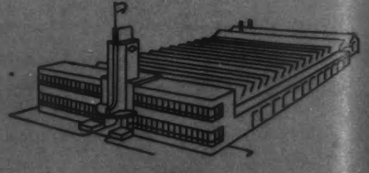

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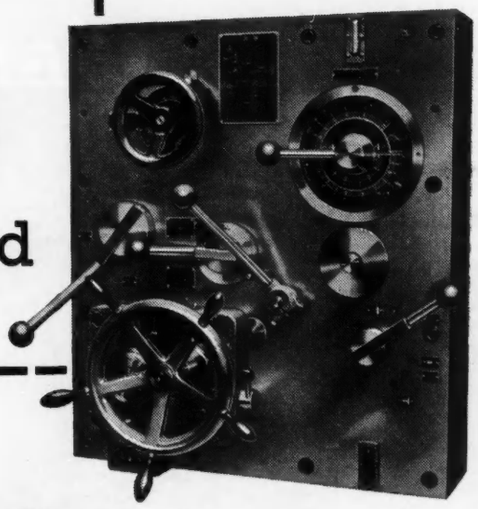
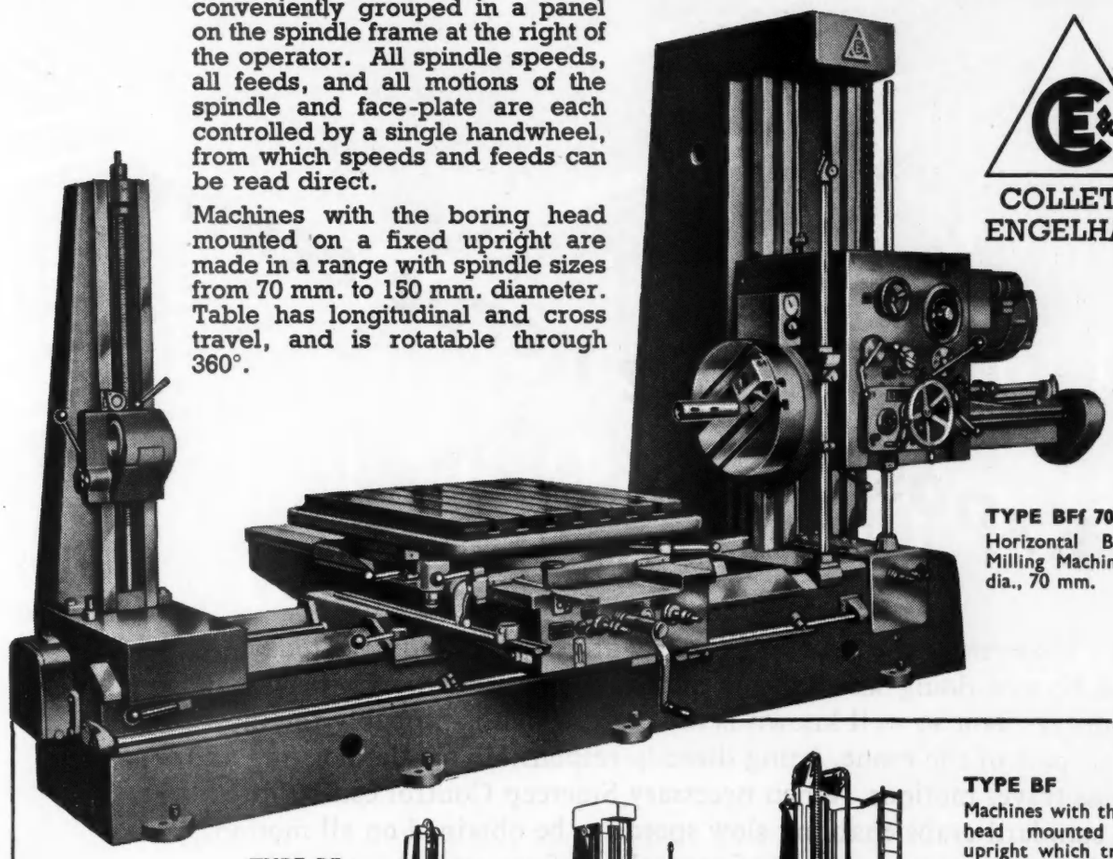
in *every* sense of the word



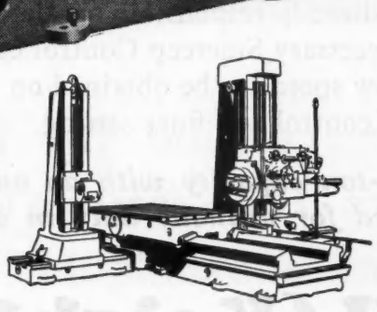
Collet and Engelhard machines have all important controls conveniently grouped in a panel on the spindle frame at the right of the operator. All spindle speeds, all feeds, and all motions of the spindle and face-plate are each controlled by a single handwheel, from which speeds and feeds can be read direct.

Machines with the boring head mounted on a fixed upright are made in a range with spindle sizes from 70 mm. to 150 mm. diameter. Table has longitudinal and cross travel, and is rotatable through 360°.

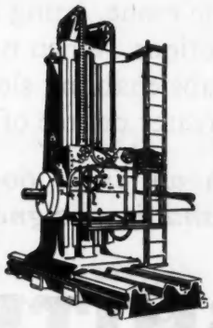
COLLET & ENGELHARD



TYPE BFf 70
Horizontal Boring and Milling Machine. Spindle dia., 70 mm.



TYPE BFc
Type with table travelling cross to spindle axis. Upright travelling in the direction of spindle axis. Supporting standard adjustable in the direction of spindle axis. Spindle sizes, 115 mm. to 175 mm. dia.



TYPE BF
Machines with the boring head mounted on an upright which travels on a bed at right angles to the spindle axis are available with spindle sizes from 100 mm. to 300 mm. dia. There are other floor types with revolving upright and/or with swivelling headstock, etc.

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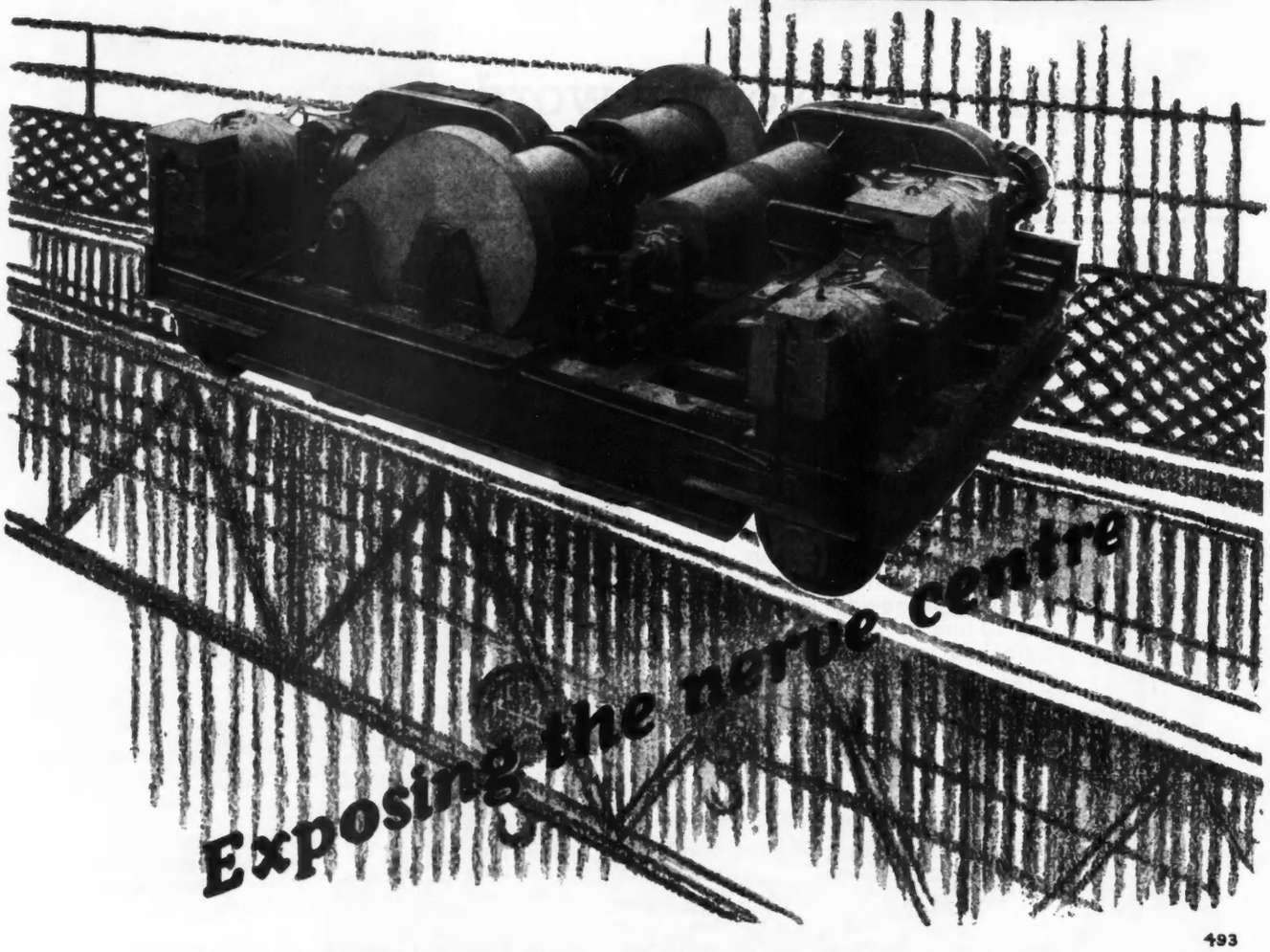

493

The modern overhead crane is an essential unit of industry today, and can be seen doing scores of different jobs in various works throughout the country. Not so well known is the crab, which is probably the most vital part of the crane, being directly responsible for the hoisting and cross travel motions. When necessary Stacreep Control can be fitted to standard crabs enabling slow speeds to be obtained on all motions, giving a far greater degree of control and finer setting.

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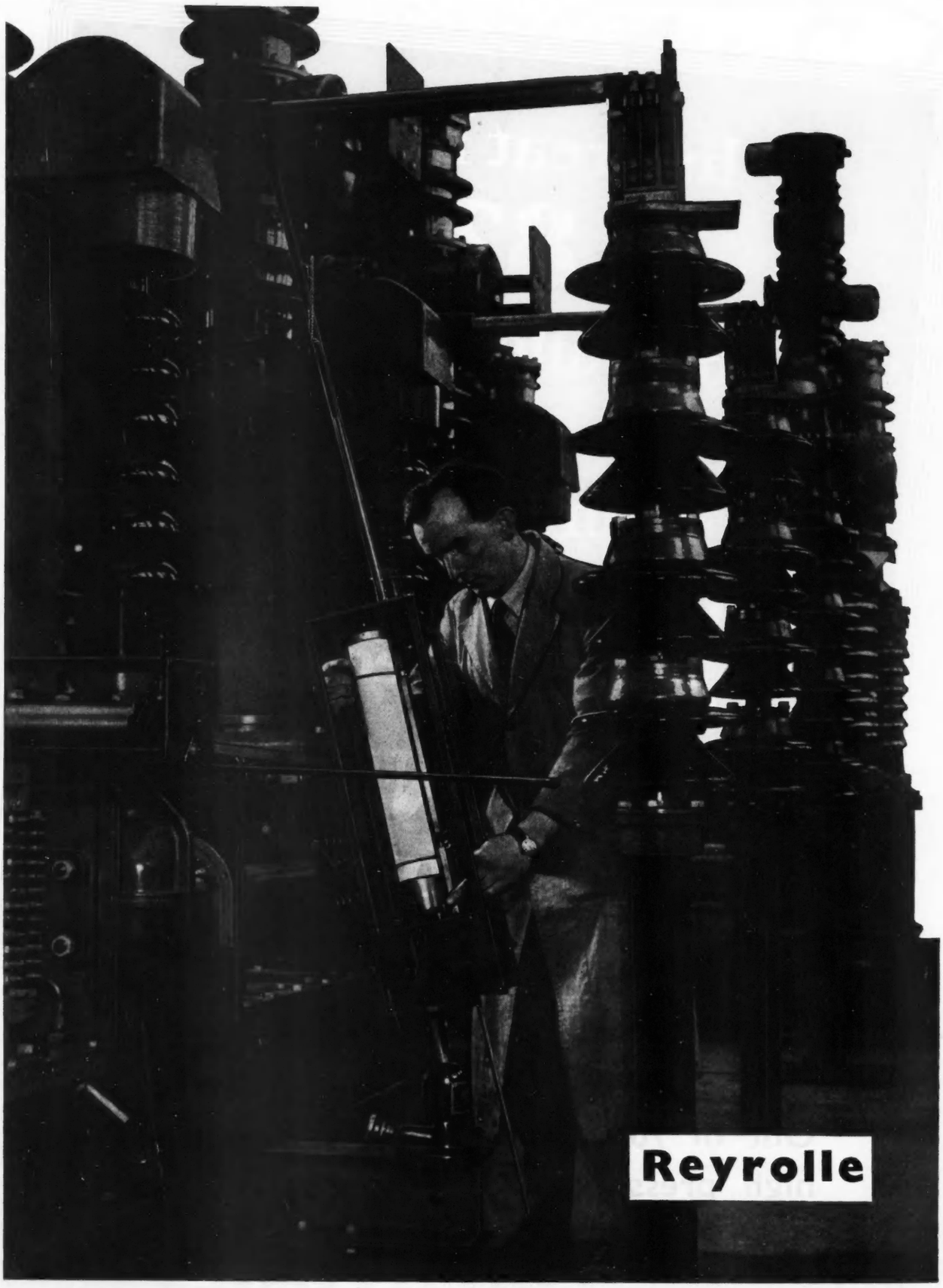

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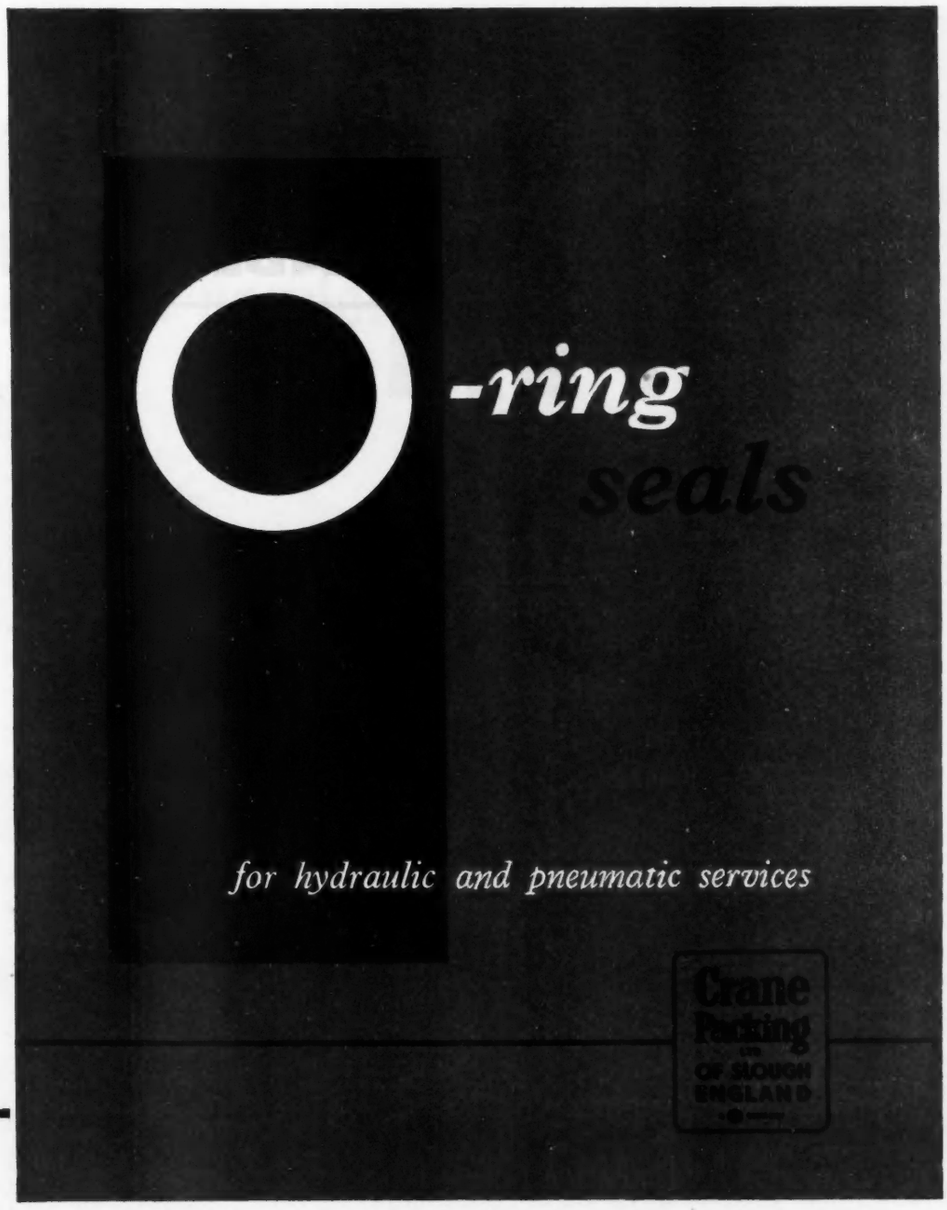

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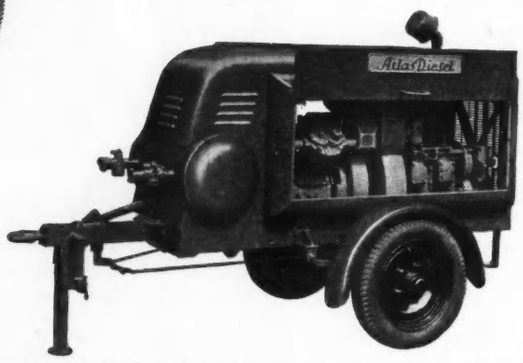
(63 cu. ft. per min. Free Air Delivered)

The *only* completely air-cooled single tool portable compressor on the market. Powered by an Armstrong Siddeley twin cylinder air-cooled diesel engine, coupled to a two-stage air-cooled Atlas Compressor. Flywheel fan draws air not only over finned cylinders and cylinder head but also through the engine crank-case to assist in cooling the lubricating oil.



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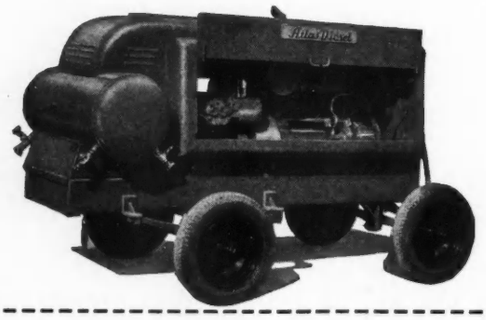

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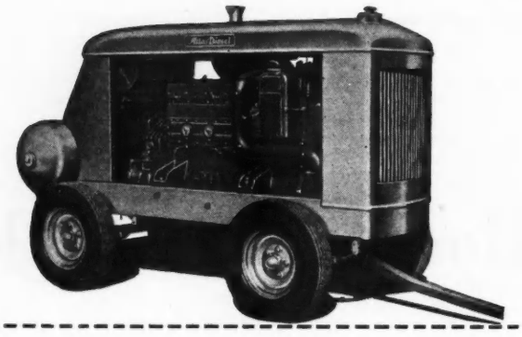

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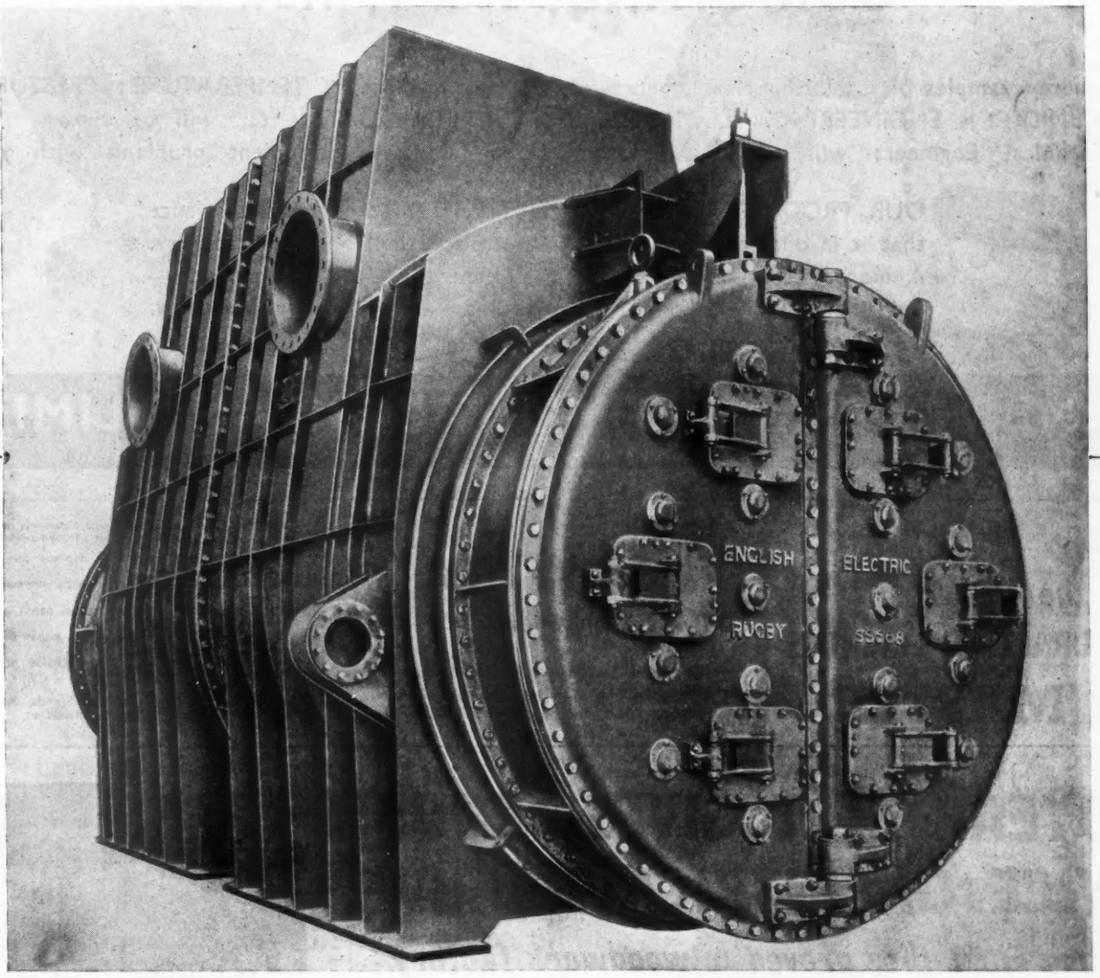

One shell of a twin shell condensing plant for a 60,000 kW turbo-set

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On the manufacturing side, Goodyear transmission belts are giving highly satisfactory performance under the toughest working conditions.

On this sanding machine, for example, a Goodyear Endless Cord belt is giving outstanding service. Here, the 35 h.p. drive entails six changes of direction, combined with a regular lateral movement of the roller pulleys. Belt speed is over 2,000 feet per minute. Goodyear Endless Cord belts were adopted after other types of belt had been proved unsuitable for the drive.

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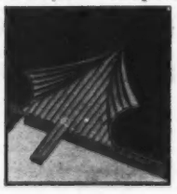
A belt with exceptional flexibility that permits greater speed over small pulleys. The load is carried by a central layer of robust, low stretch cords, continuously wound so that joints are eliminated. Balanced construction of the cords and of the tough fabric envelope ensure true running. The Goodyear Endless Cord Belt carries 33⅓% more load than any other belt of equal thickness.



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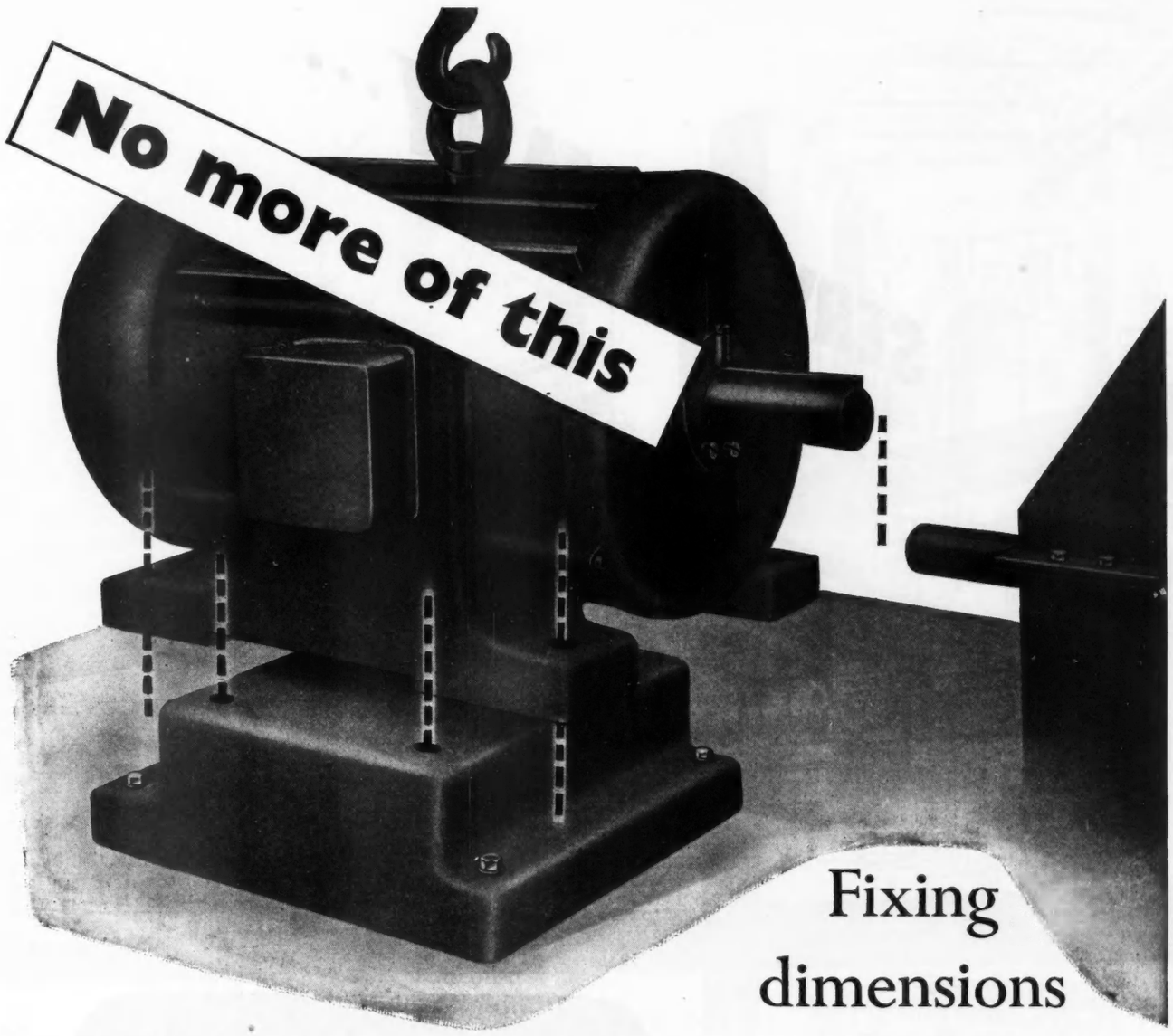
Goodyear Endless Cord Belts successfully tackle a complicated drive with six changes of direction. This is a sanding machine in the woodwork factory of Craigs Ltd., timber merchants of Widnes. Tough, dependable Goodyear belts are used exclusively throughout the plant. (NOTE. The guards have been temporarily removed from this drive to facilitate photography.)



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Leading motor manufacturers in this country have collaborated in the design of a range of totally-enclosed fan-cooled, foot mounting, squirrel cage motors having outputs up to 25 hp. at 2 pole speeds. These machines, rating for rating, will all be built to the same leading dimensions which will be laid down in a British Standards specification. This move to standardise motor fixing dimensions meets a widespread demand and will ensure that when motor replacement is necessary, lost production time is reduced to a minimum.

METROVICK are manufacturing a new range of machines which comply fully with British Standard Draft Specification CN(ELE) 6814. The M.V. range is known as:

TYPE KNB MOTORS

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One of the totally enclosed, fan-cooled, Type KNB motors with standardized fixing dimensions.

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METROVICK *motors ready for world-wide service*

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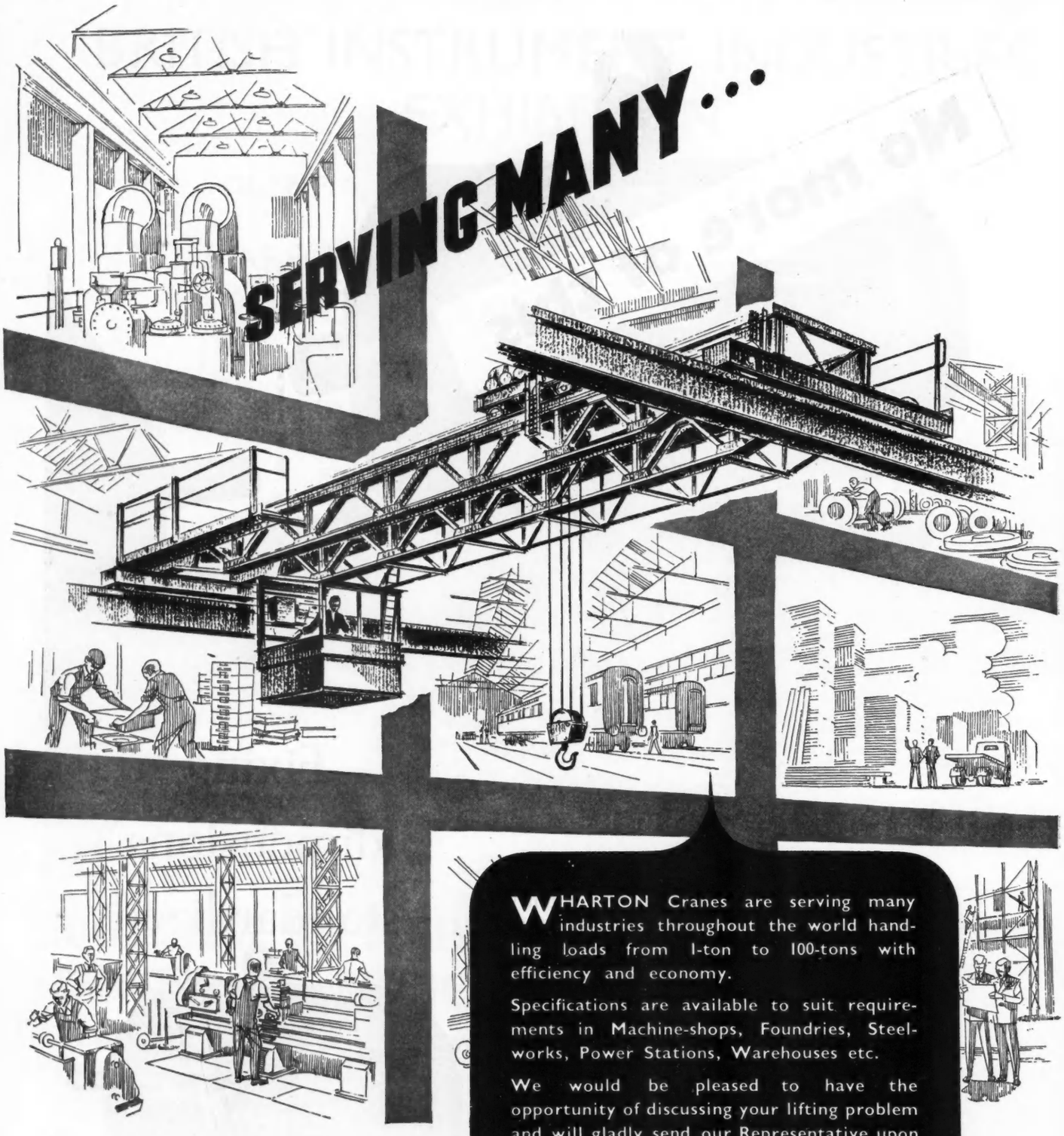

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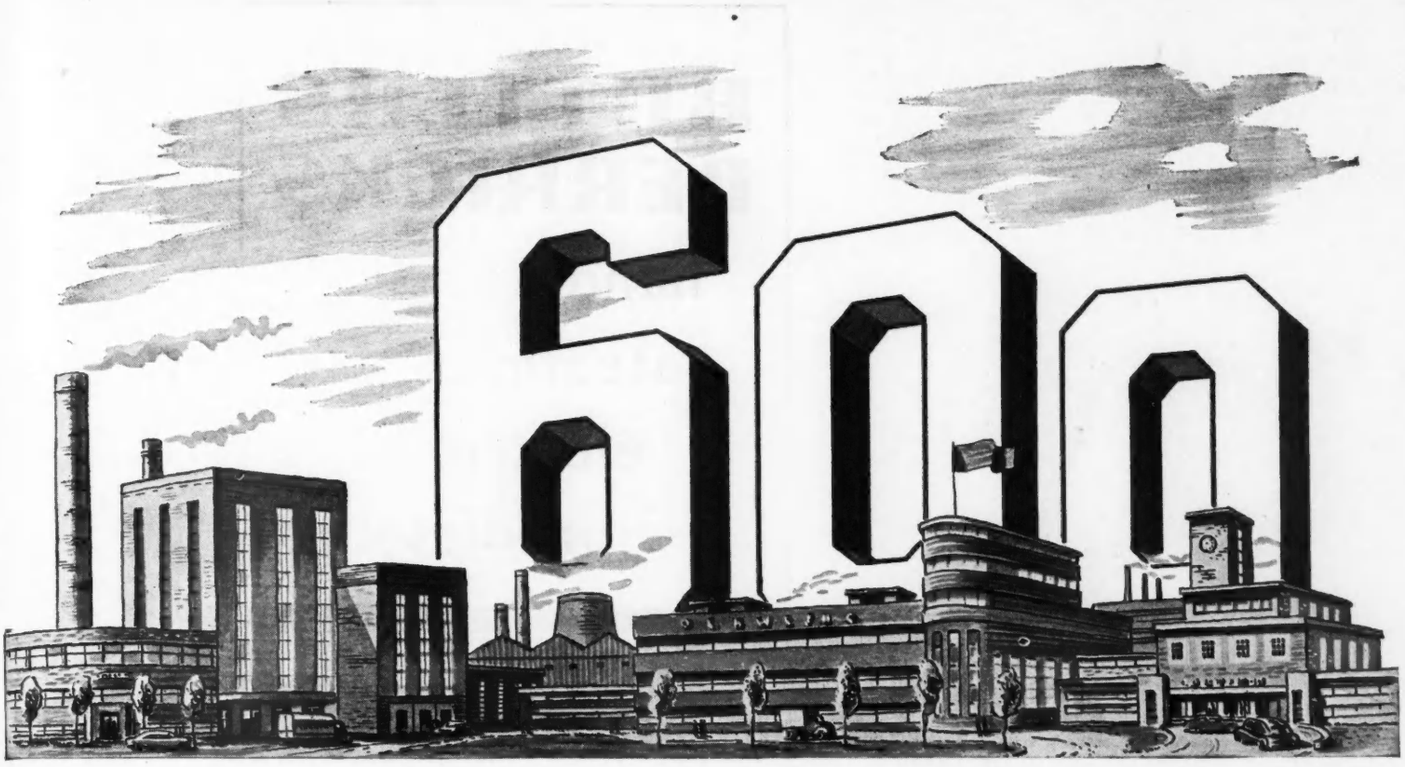

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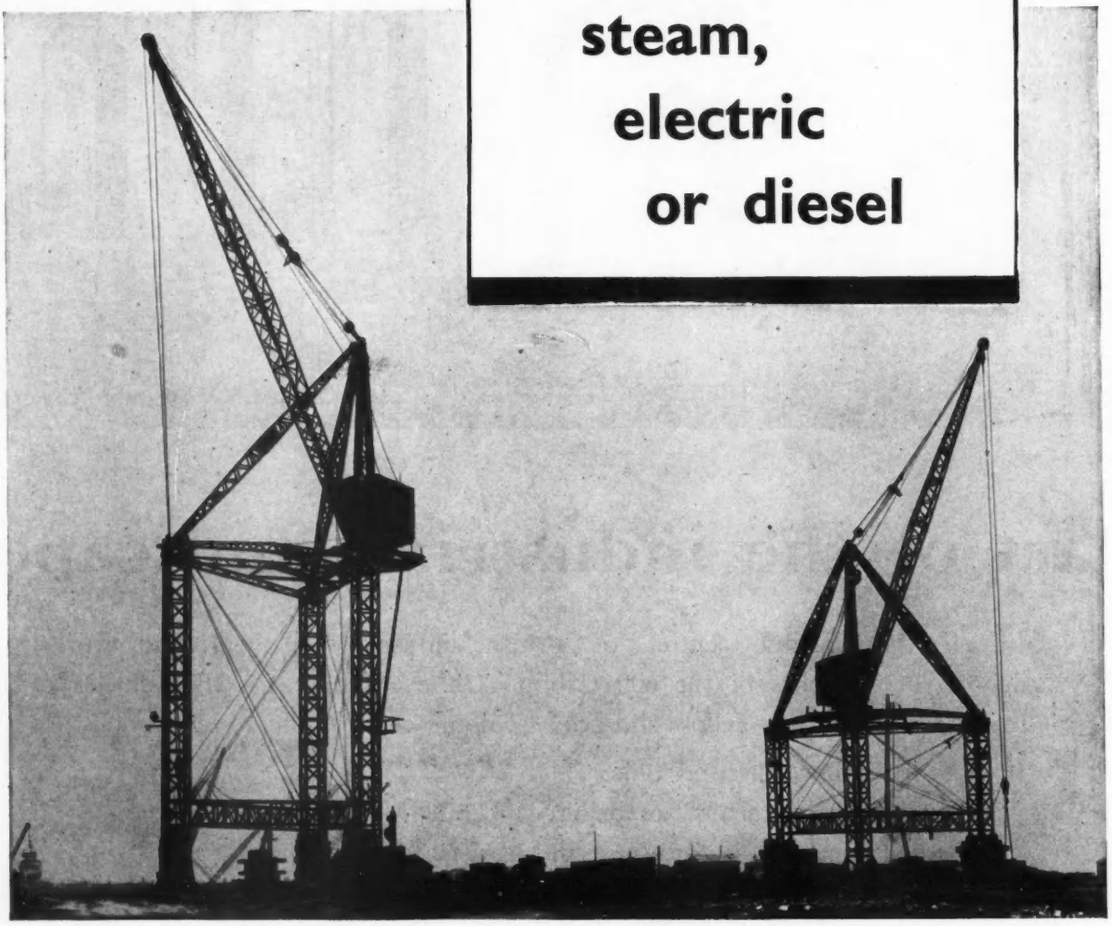

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Lifting capacity is 30 tons at 90ft. radius and 12 tons at the maximum radius of 116ft.

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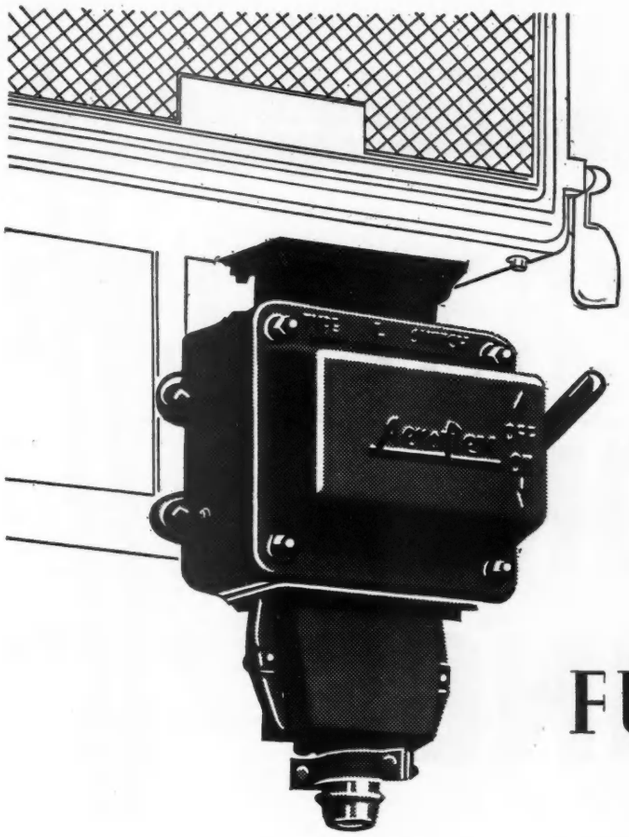

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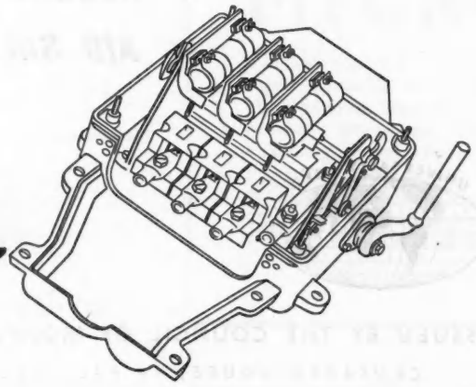

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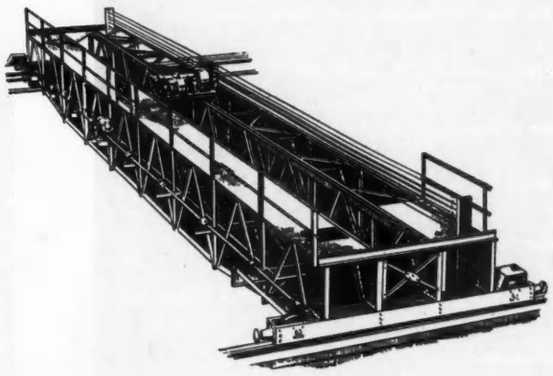

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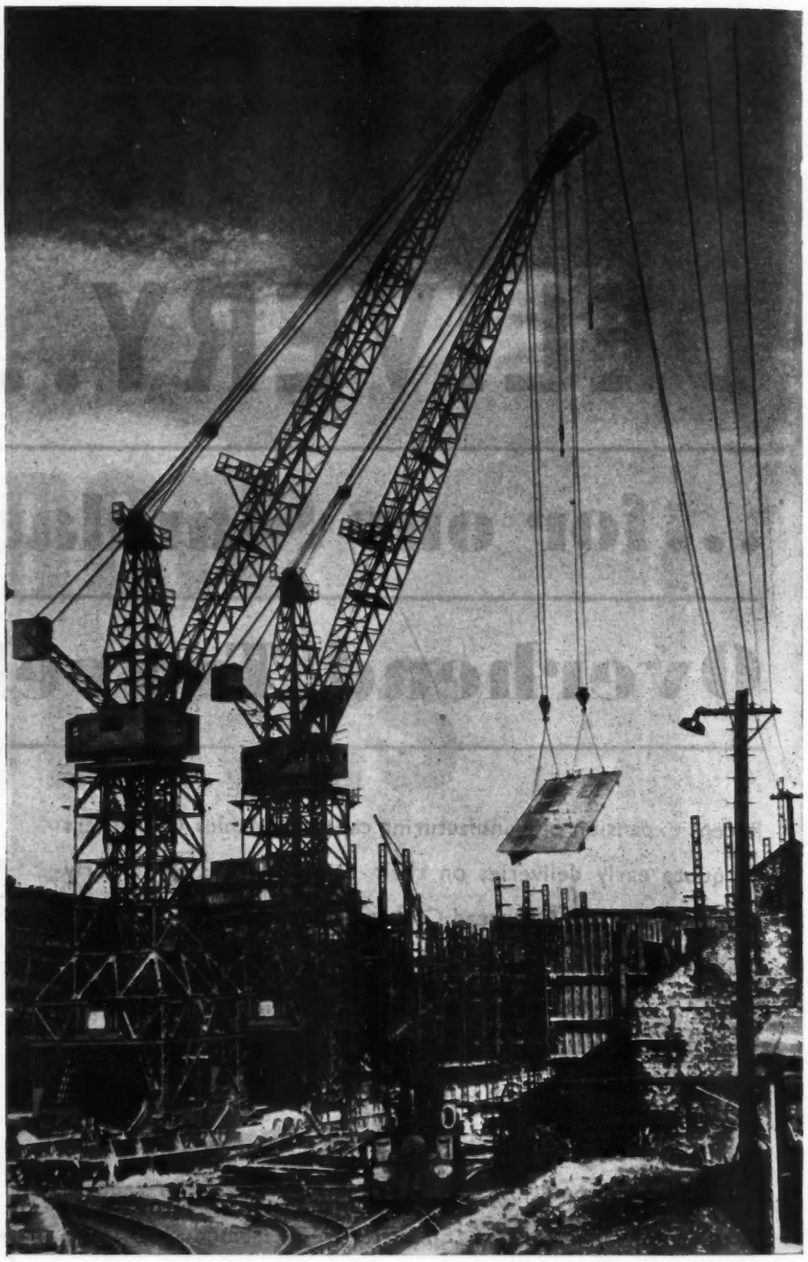
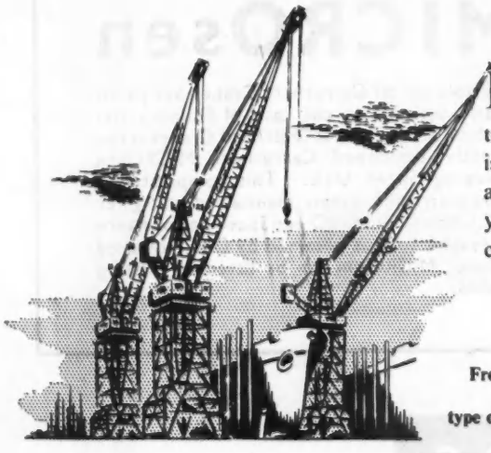
BOOTH

shipyard cranes

The illustration shows a Booth shipyard crane installation supplied to Hawthorn, Leslie & Co. Ltd., Shipbuilders of Hebburn-on-Tyne. Lifting capacity is 15 ton at 100'-0" radius with 6 ton lifting at 136'-0". An additional fast hoist is fitted for use with light loads of 3 tons and under up to a radius of 142'-0".

The Cranes are semi-level luffing to the main hook.





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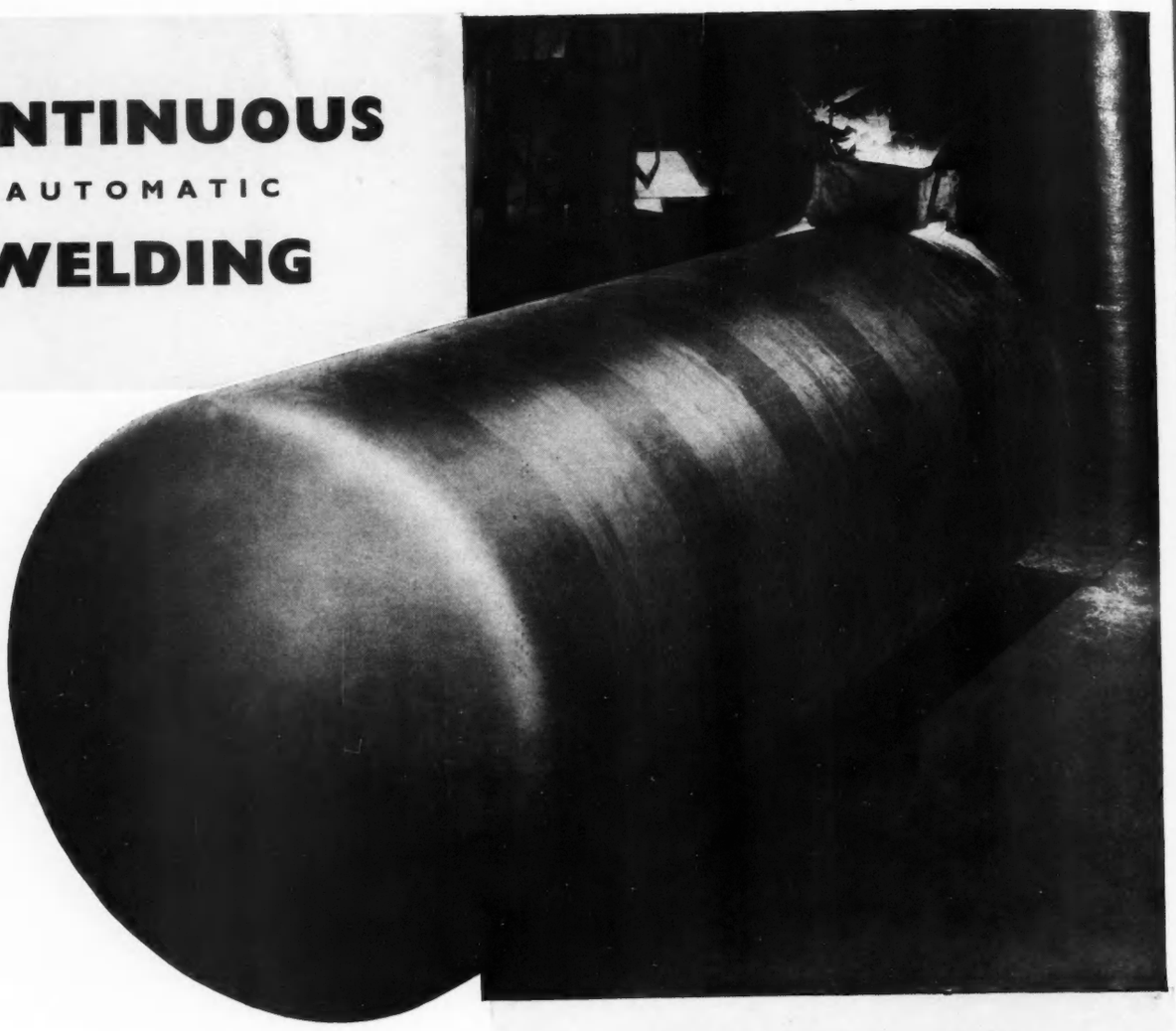

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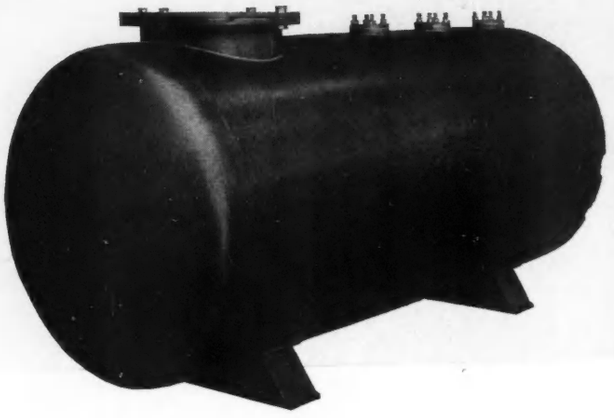

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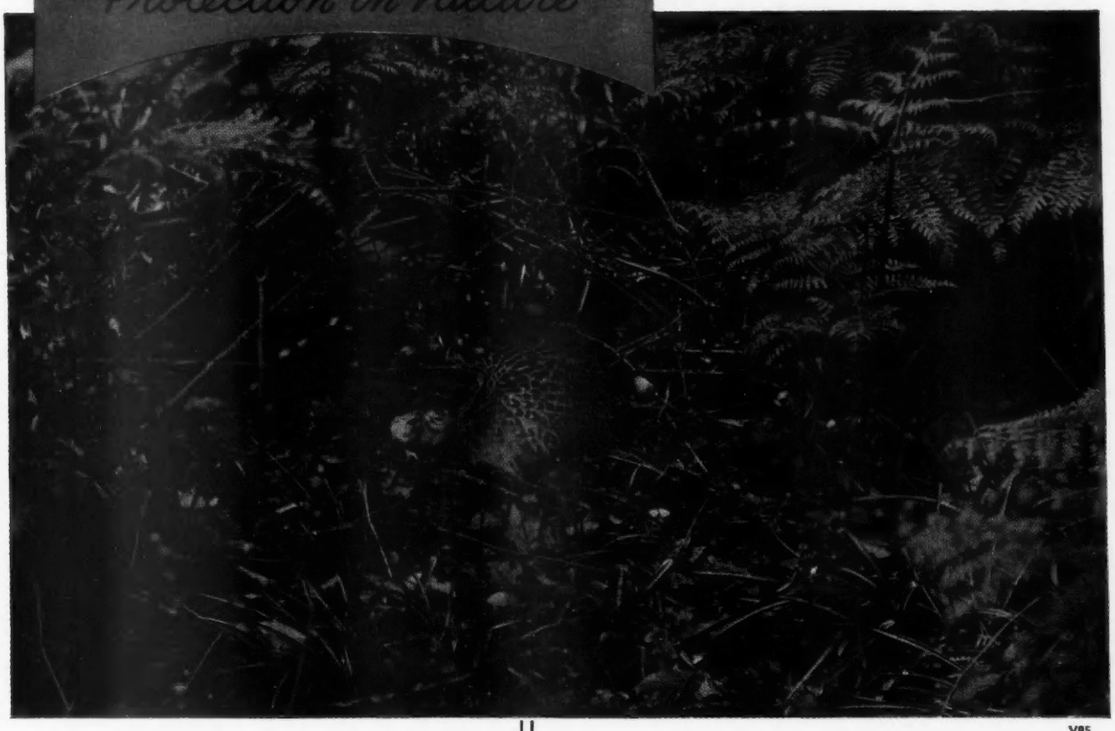

V85

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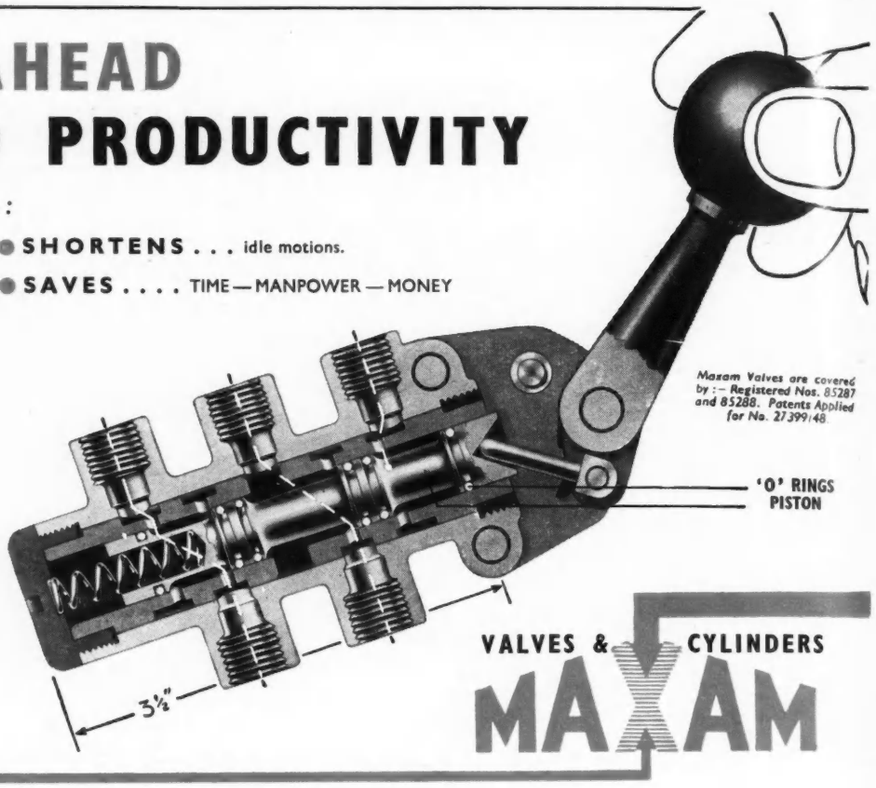

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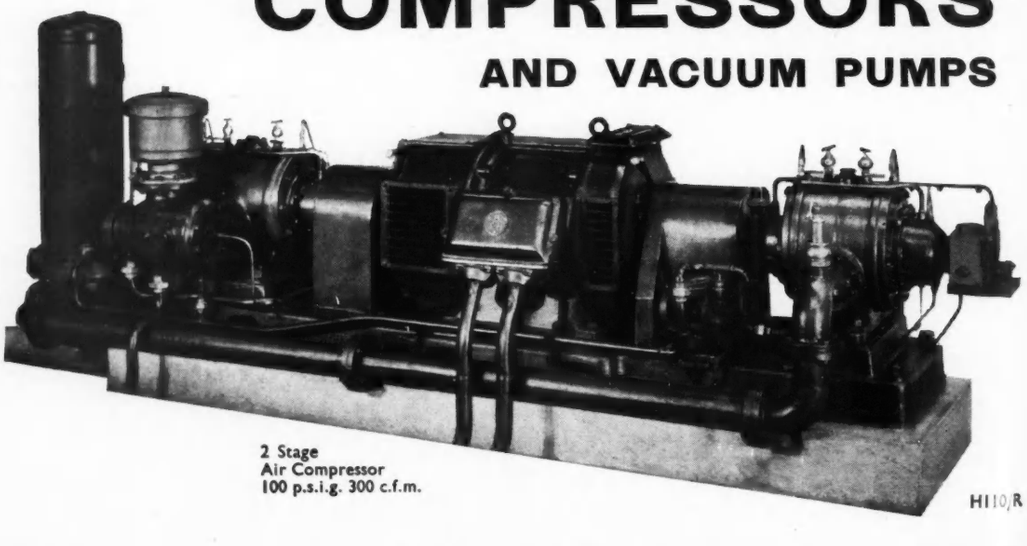

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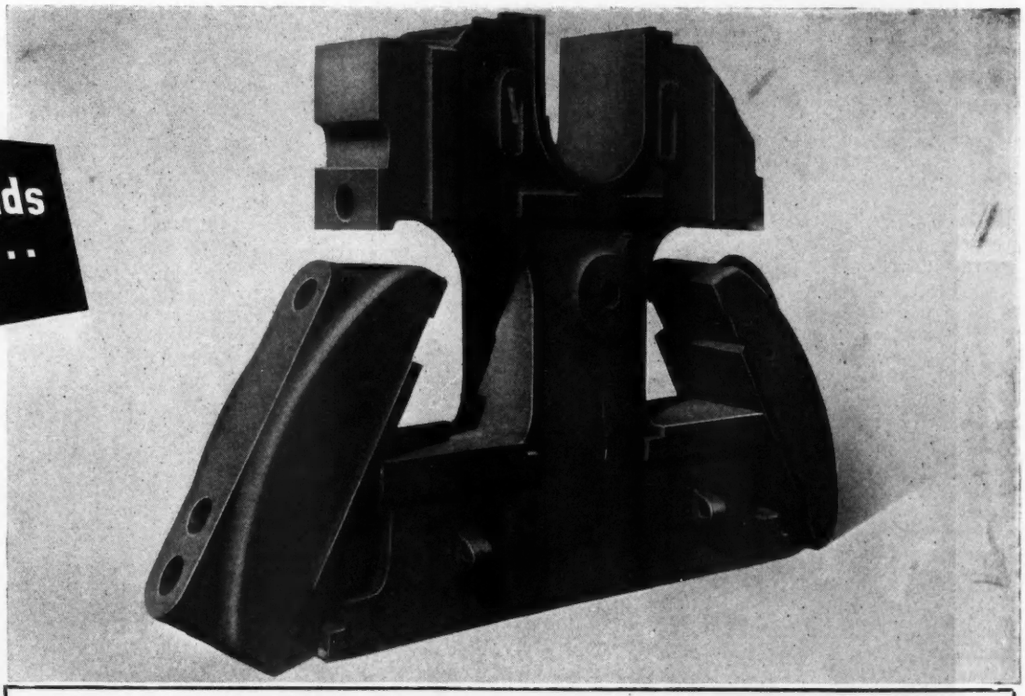

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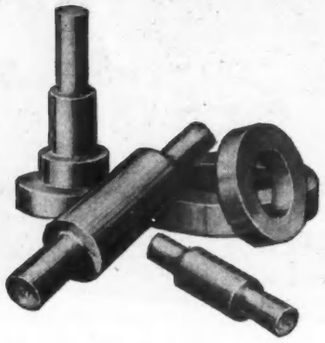

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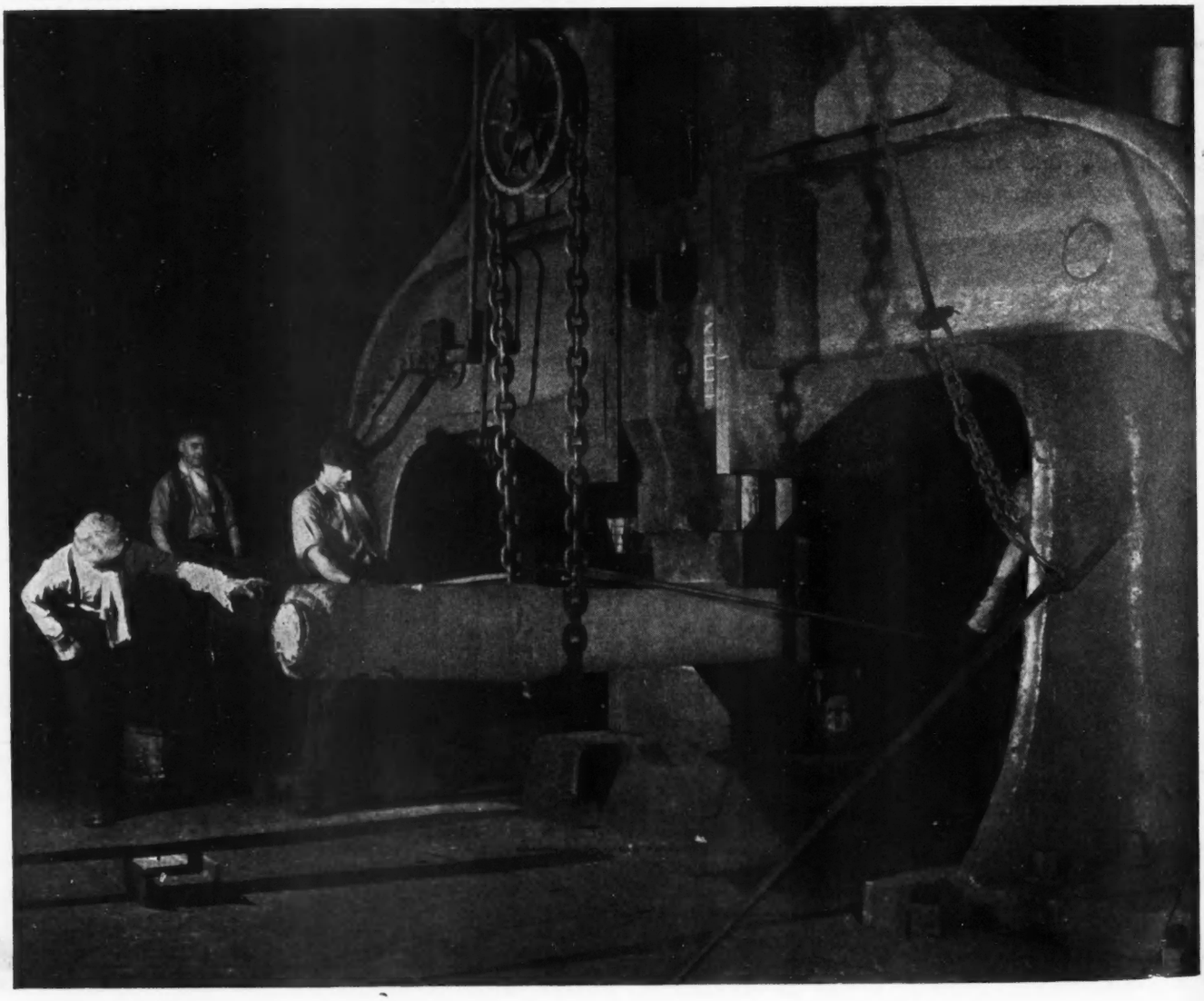

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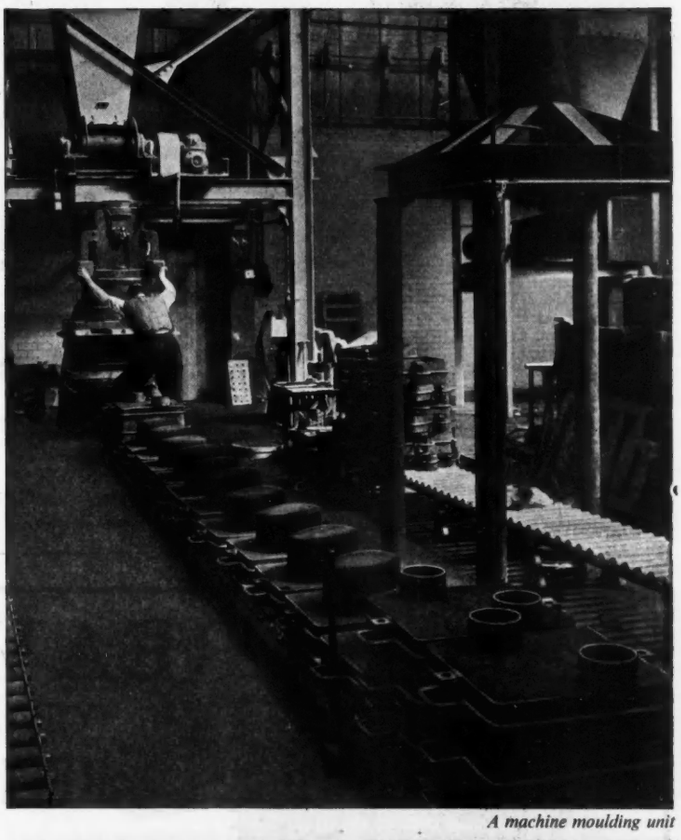

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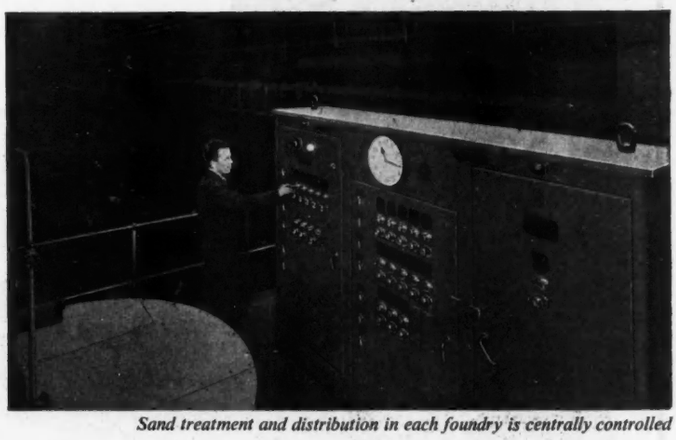

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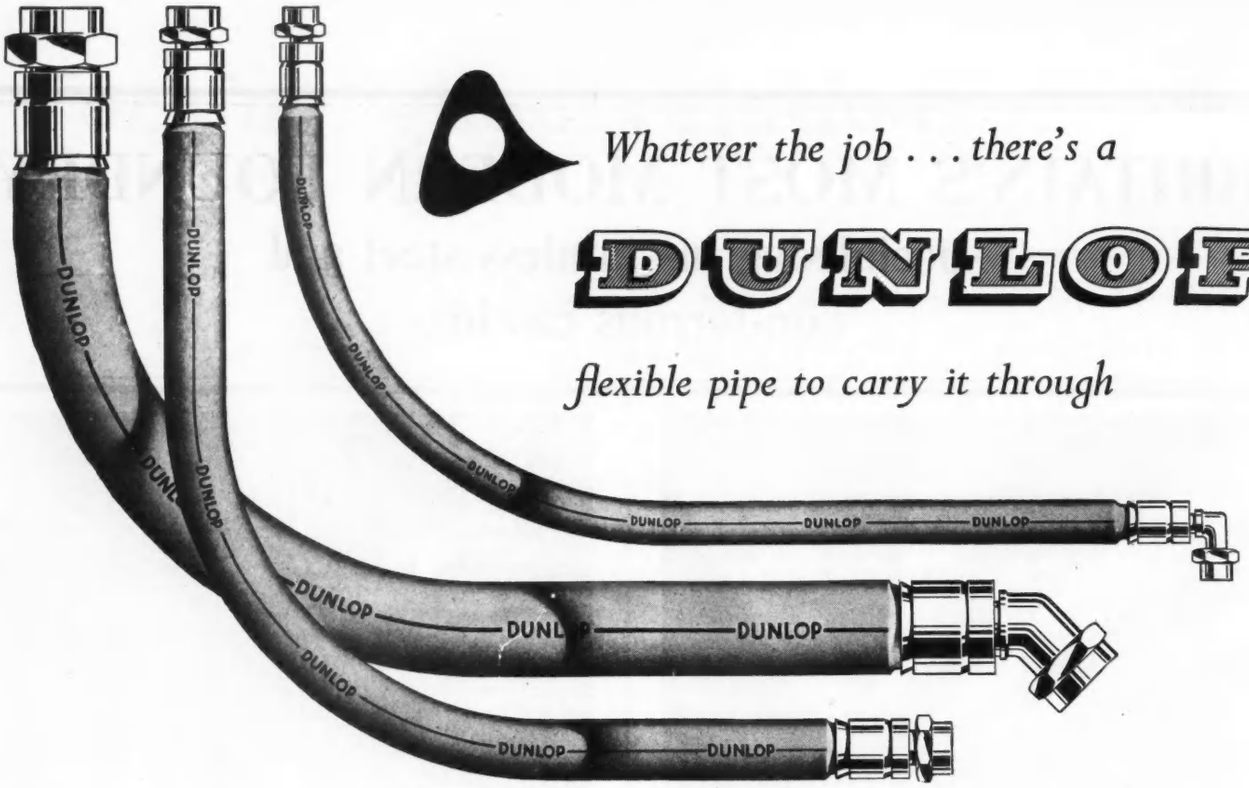

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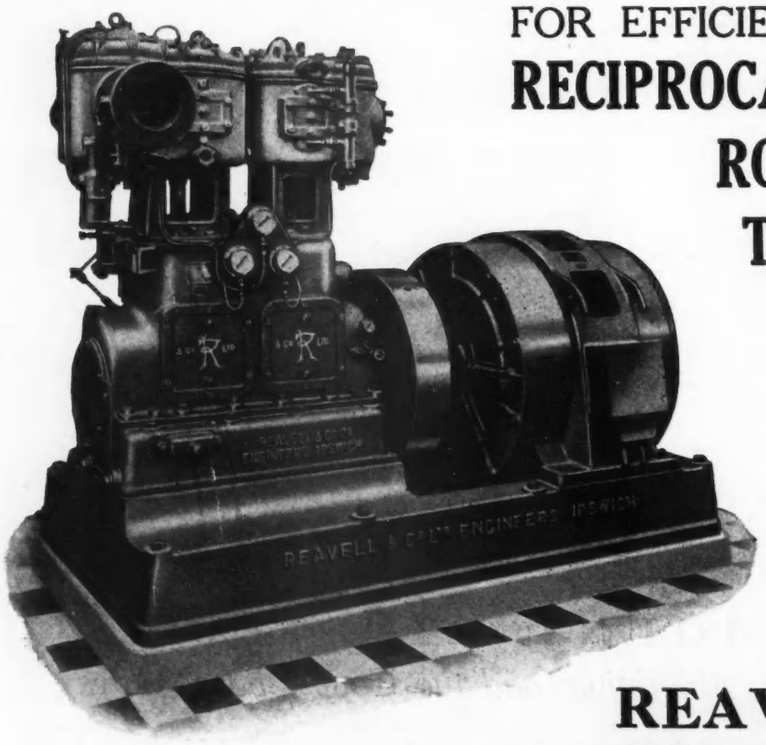

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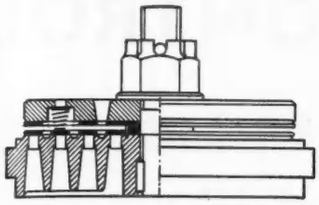

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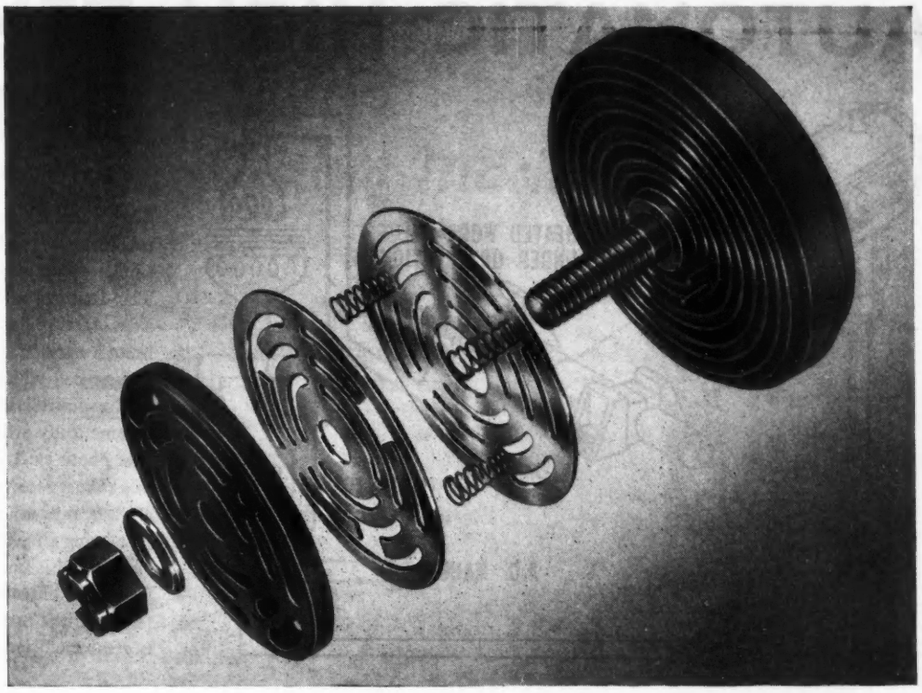

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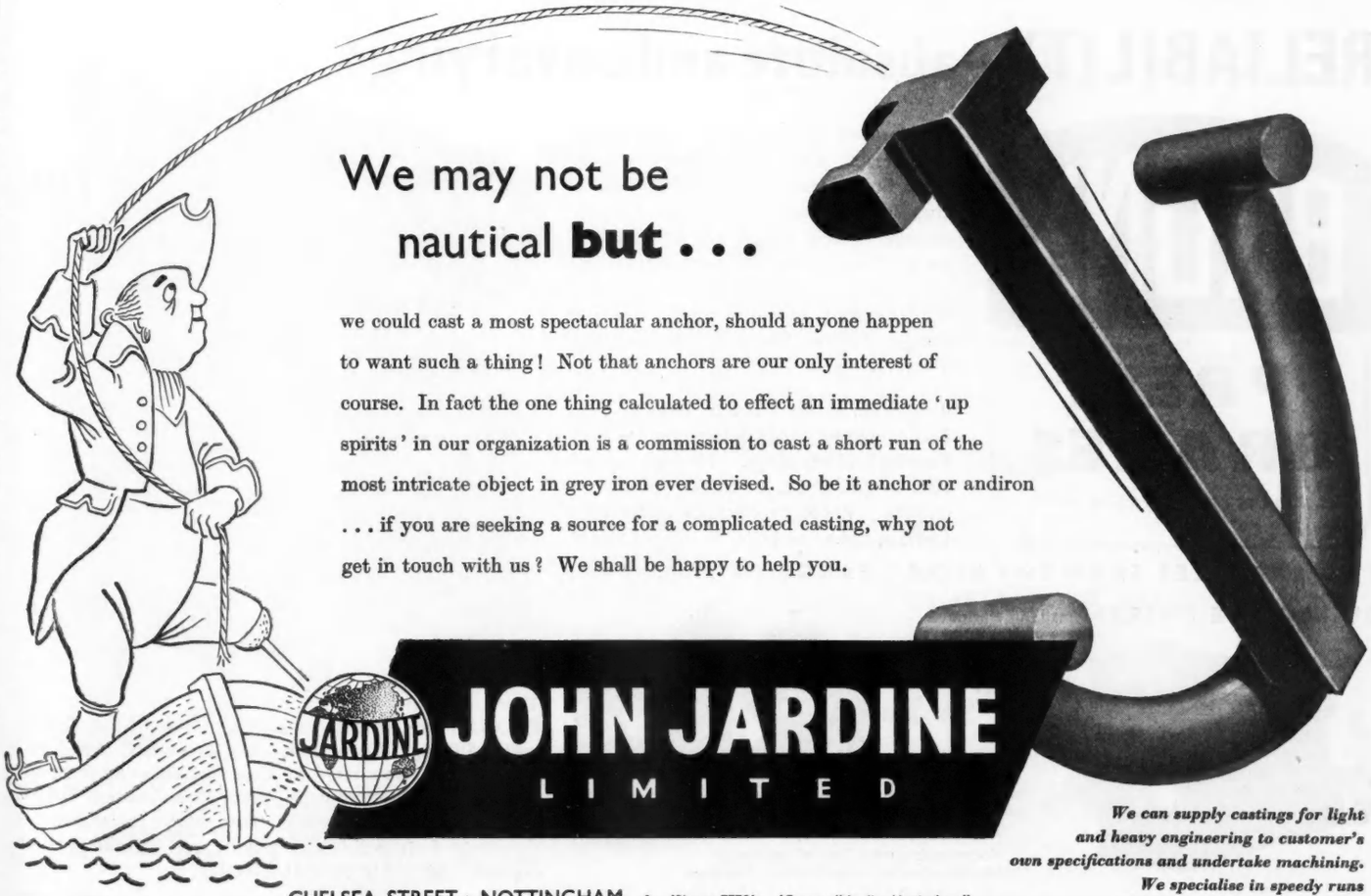

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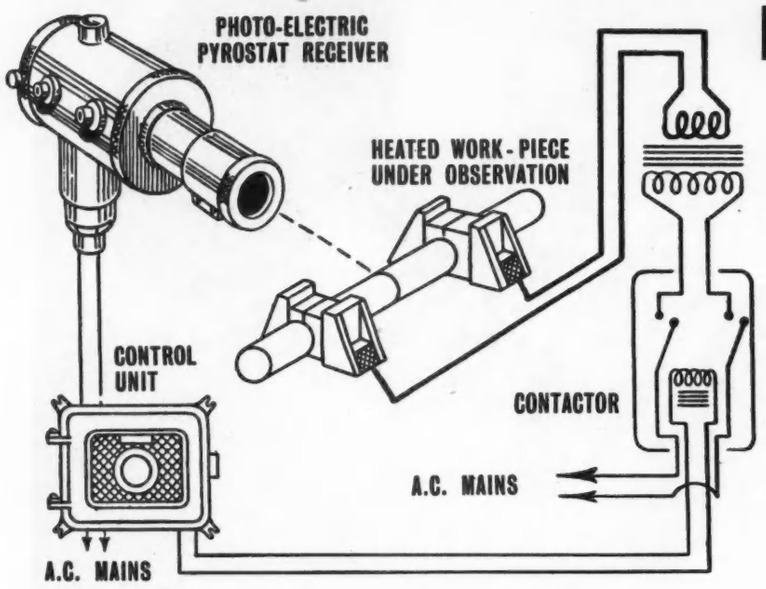

The difficulty of controlling temperature when employing direct resistance or eddy current heating in butt welding, up-setting and similar operations is well known.

The Radiovisor Pyrostat Controller provides automatic and instantaneous control by measuring the visible light radiations emitted from the heated workpiece. Radiations from the workpiece fall on to a photo-electric cell which converts light intensity into electrical energy, and at the desired temperature the heating current to the workpiece is automatically switched off.

The photo-electric cell which is instantaneous in response, is mounted in a robust receiver housing, which carries an infra red filter to exclude all light rays other than those radiated from the hot workpiece.

Not being in physical contact with the heated workpiece the photo-electric cell is unaffected by the intense heat. Once set, the Radiovisor Pyrostat Controller requires no further attention and does not interfere with the operator or operation. The only reminder of its presence is greater efficiency and increased production.

OTHER RADIOVISOR PHOTO ELECTRIC AND ELECTRONIC CONTROLS INCLUDE:

FLAMESTAT FLAME FAILURE CONTROL · HOPPER AND BUNKER LEVEL CONTROL · PROTECTIVE GUARD RAY · INDUSTRIAL SMOKE DENSITY INDICATOR · SMOKE ALARM FACTORY LIGHTING CONTROL · ESCALATOR AND LIFT CONTROL COUNTING AND BATCHING UNIT · PRINT REGISTRATION · SMOKE DETECTOR FIRE ALARM · INVISIBLE RAY BURGLAR ALARM · AUTOMATIC DOOR OPENING.

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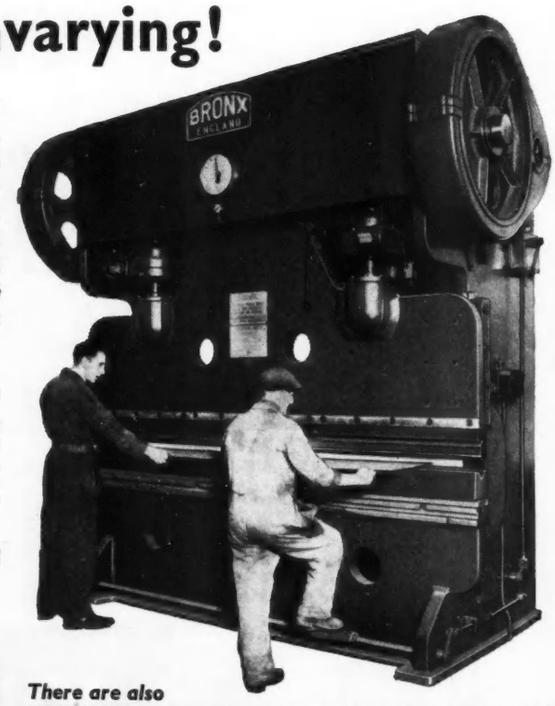
For forming sections in all metal, in all thicknesses, up to 20 ft. wide—Bronx Press Brakes are faster and more versatile than folding machines and are of exceptionally massive design and construction. Bronx Press Brakes will form sharp bends to extremely fine limits and can be tooled for punching, shearing and notching. Range of sizes from 20 to 1000 tons pressure.

Illustration shows a Bronx 160-ton Press Brake, used for forming sections, channels, flanging and pressings. Normal capacity 10ft. by ¾in. thick, or thicker in shorter lengths. Photo by courtesy of Fisher & Ludlow, Ltd.



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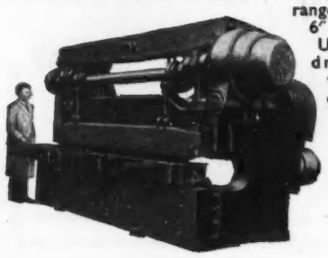

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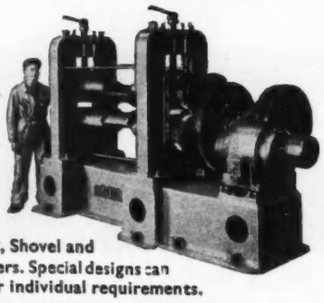
As used by Fork, Shovel and Hoe manufacturers. Special designs can be submitted for individual requirements.



There are also BRONX Plate bending rolls—Cold rolling sheet & Strip mills—Slitting & Coiler units—Sheet levellers—Bulldozers—Hydraulic stretchers—Section straightening machines—Plate straightening rolls—Heavy bar shears—Tube & Bar reelers — Mechanised Troughing for reelers — Complete butt weld tube plants, etc. Catalogues on request. BRITISH THROUGHOUT.

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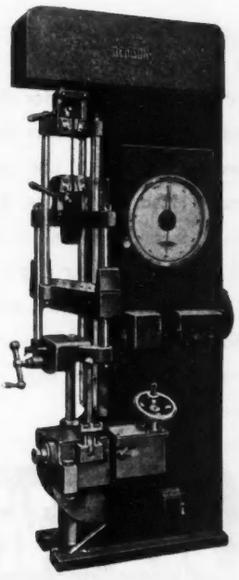

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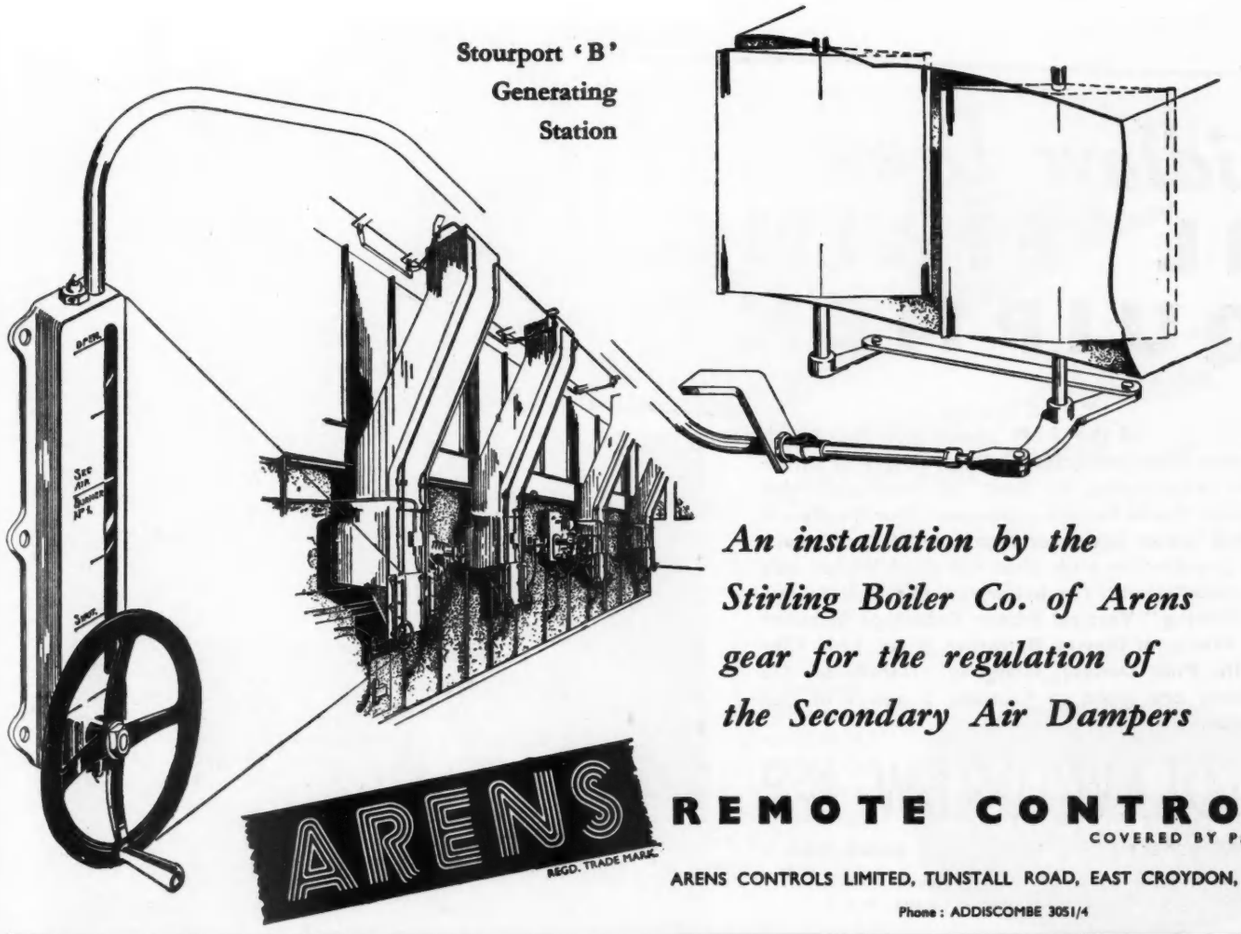

An installation by the Stirling Boiler Co. of Arens gear for the regulation of the Secondary Air Dampers

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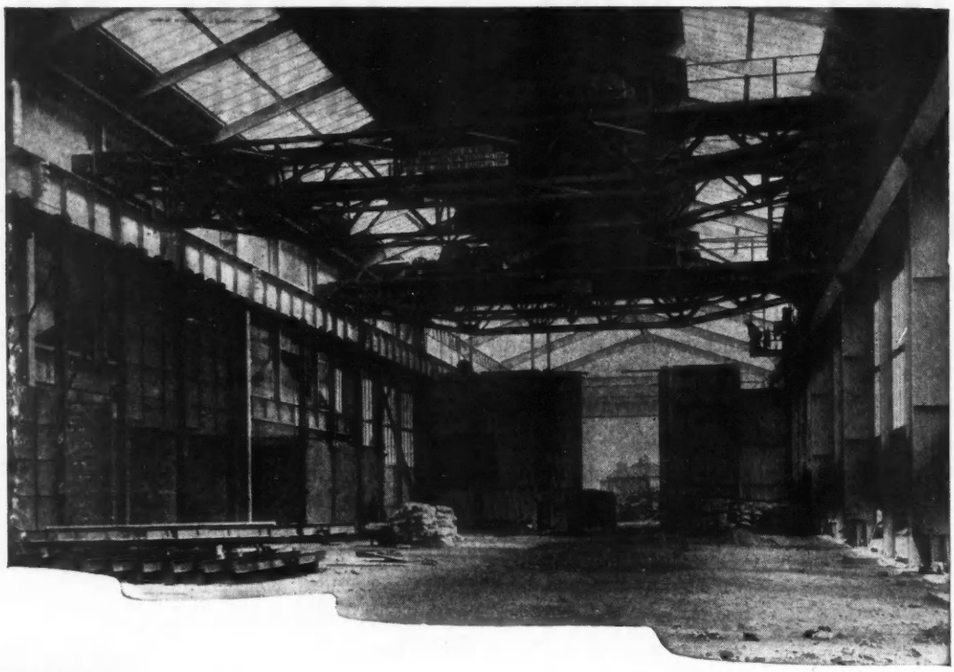

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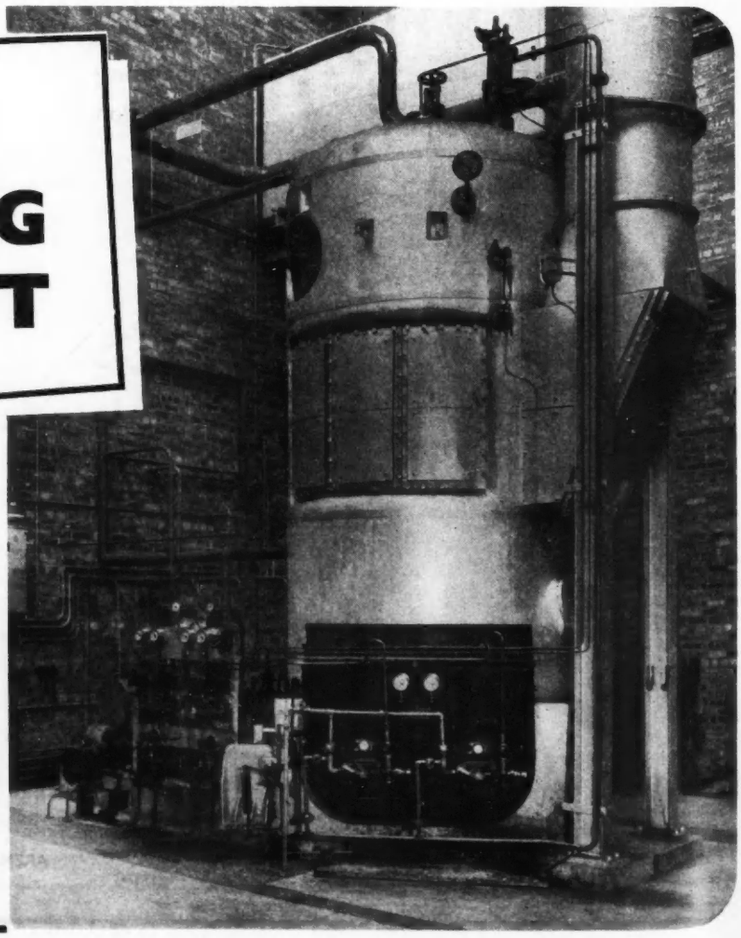

of the ALM Steam Jet Type with Automatic Modulating Flame Controls giving simultaneous adjustment to both oil and air, also Pyroscopic Flame Failure equipment. Our Condensation Feed Water Regulator with Low Water Cut-out is also provided to look after the Feed Water side of the installation. The boiler is a Marshall Anderson "Fleming" Vertical Water Tube type installed at the Works of Messrs. Brownlee & Co. Ltd., City Sawmills, Port Dundas, Glasgow. Details of this equipment are given in Sections 2 and 9 of our Catalogue.

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INDUSTRIAL RUBBER DOORS—*Eliminate Damage!*

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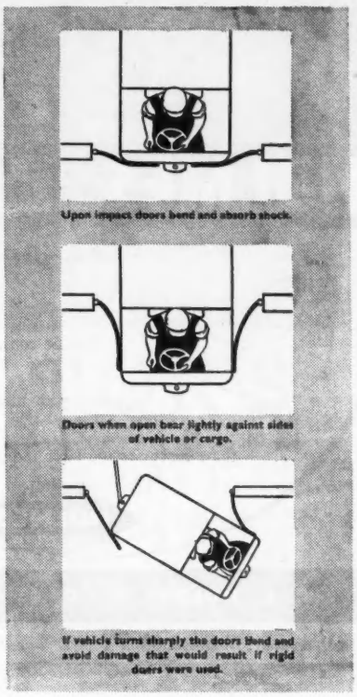
Upon impact doors bend and absorb shock.
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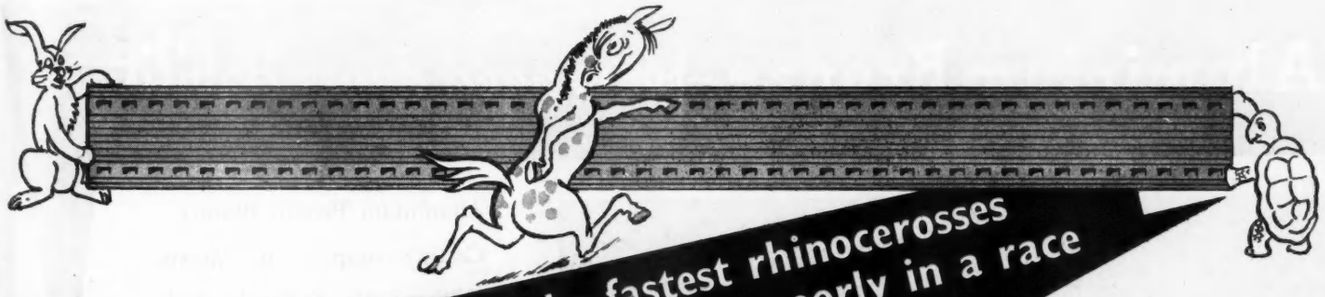

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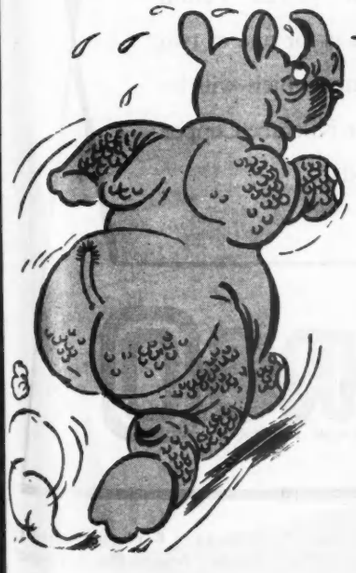

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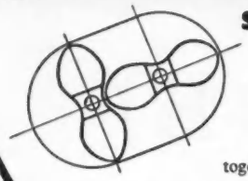

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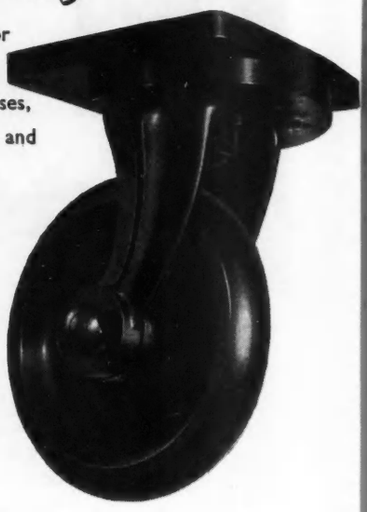

Type U/QL8. Locable truck castors with adjustable cone.

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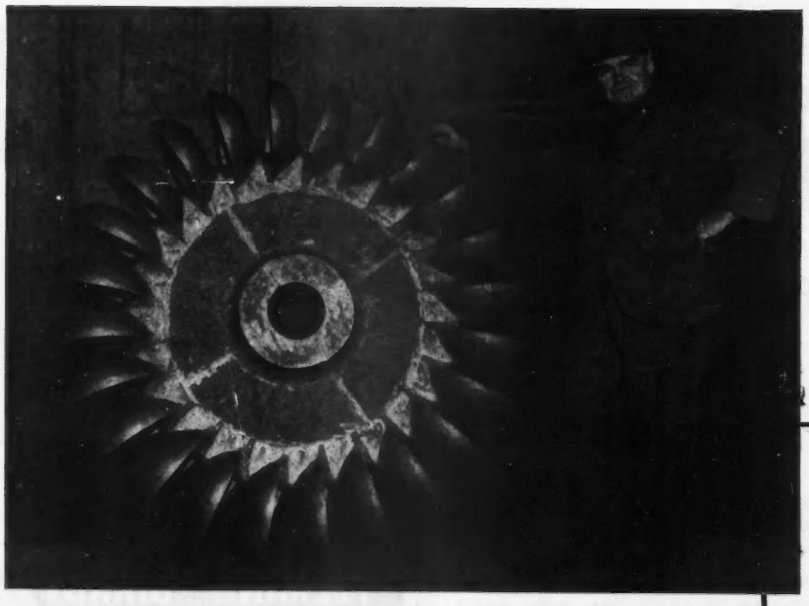
THE WHEEL MAKERS

GEO. H. HUGHES LTD., EDGEMOND AVENUE, TYBURN, BIRMINGHAM 24

Aluminium Bronze—for rugged dependability



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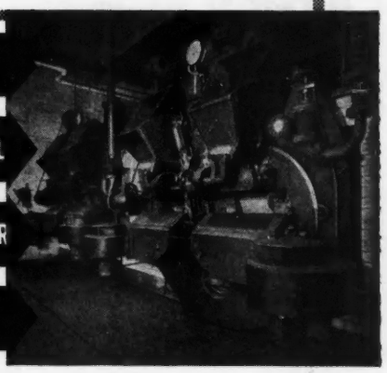

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ELECTRICALLY OPERATED VALVES AND COMPONENTS

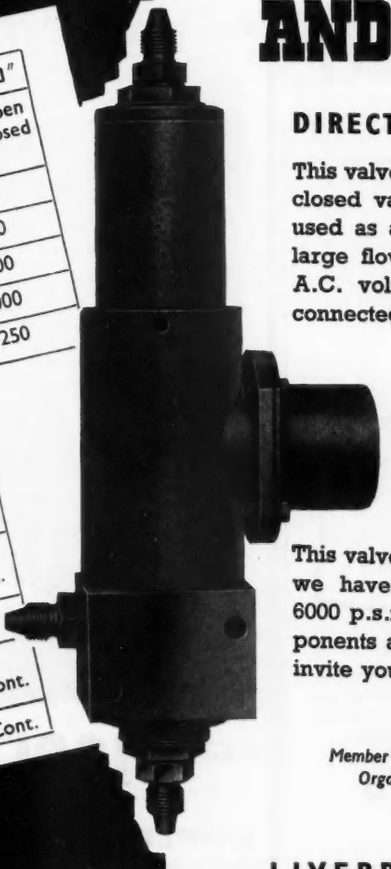
EH LIMITED

TABLE I

Standard Orifice Dia. Inches	Max. Working Pressure lbs./□" 3-Way Valve	Normally open Normally closed Valves
0.04 Dia.	6,000	6,000
0.06 Dia.	3,000	4,000
0.08 Dia.	1,000	1,500
0.10 Dia.	500	1,000
0.15 Dia.	100	250

TABLE II

Standard Voltage Range (D.C.)	Current Amps.	Rating
22-29	.672	Cont.
75-95 (115 A.C. Rectified)	.268	Cont.
100-120	.174	"
175-195 (230 A.C. Rectified)	.142	Cont.
220-240	.114	Cont.



DIRECT ACTING 3-WAY VALVE B1200 TYPE

This valve may be supplied either as a 3-way valve, a normally closed valve, or as a normally open valve. It may also be used as a pilot valve for operating relay type valves where large flows at high pressures are to be controlled. Where A.C. voltages only are available, suitable full wave bridge connected rectifiers can be supplied with the valves.

Table 1 gives the size of orifices which may be fitted with the corresponding maximum working pressures.

Table II gives the voltage current characteristics for this type of valve. The graph shows the flow characteristics.

This valve is just one of a wide range of valves and components we have developed, suitable for working pressures up to 6000 p.s.i. for Industrial applications. Many of these components are covered by Buxton Flameproof Certificates. We invite you to discuss your project with us.

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corrosion-

destroys
machinery
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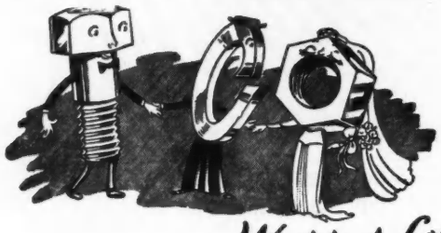

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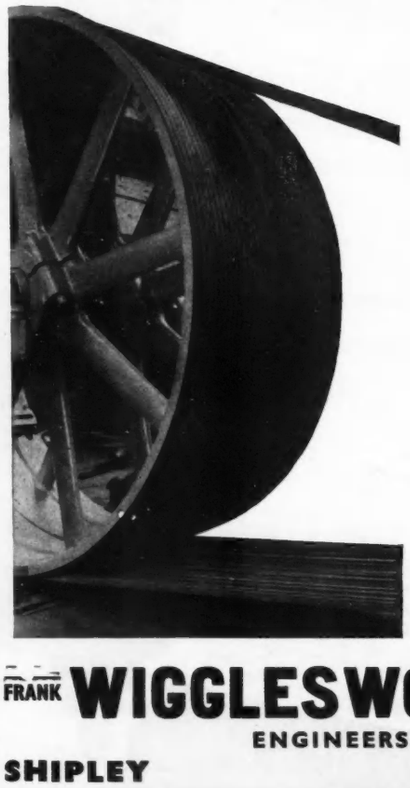

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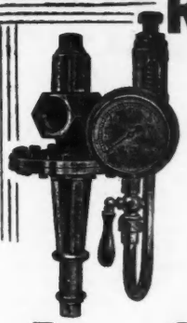

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SQUARE PATH alternators by **BRUSH**

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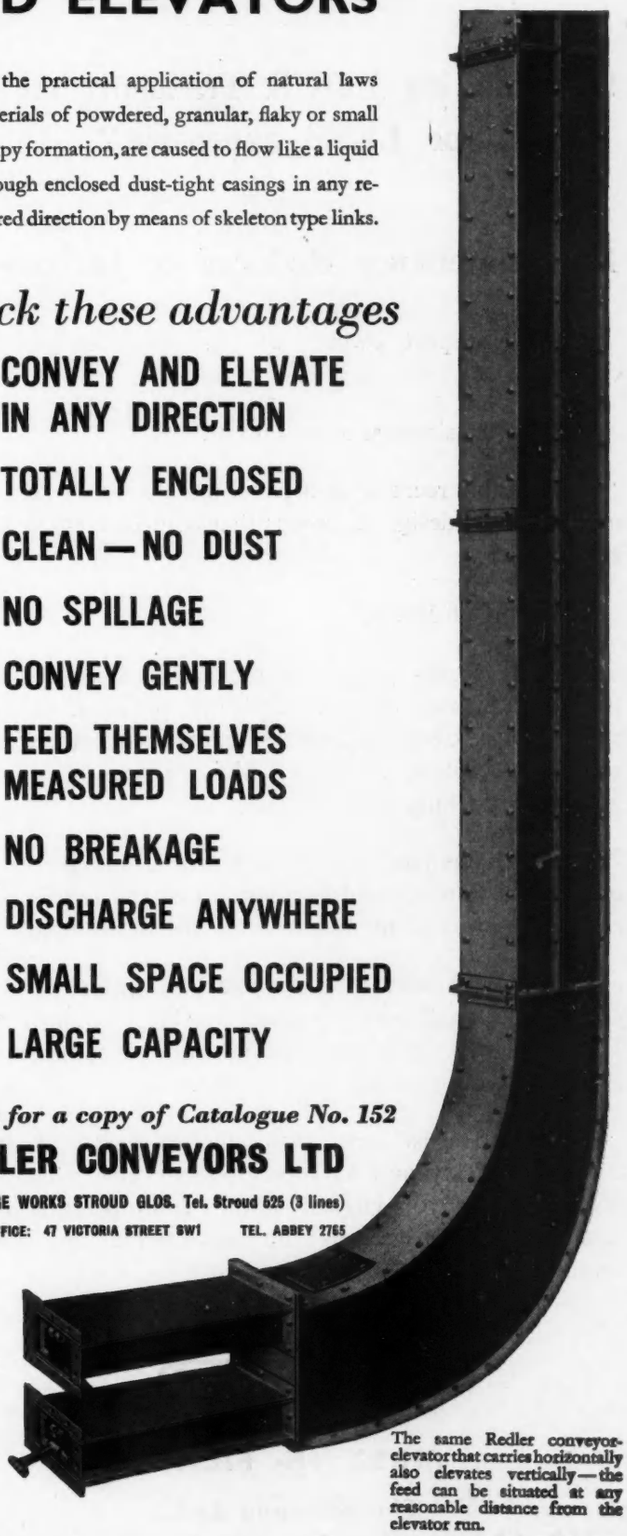

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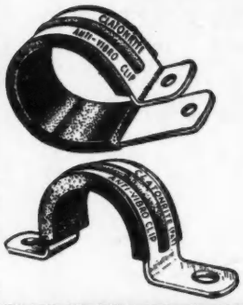

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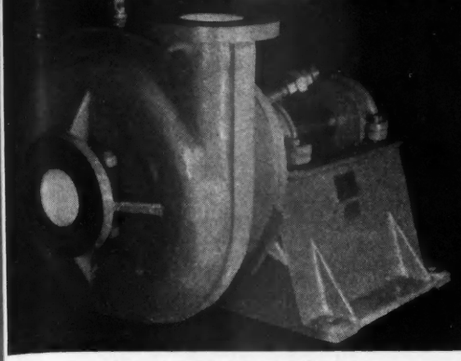

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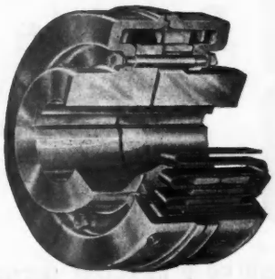

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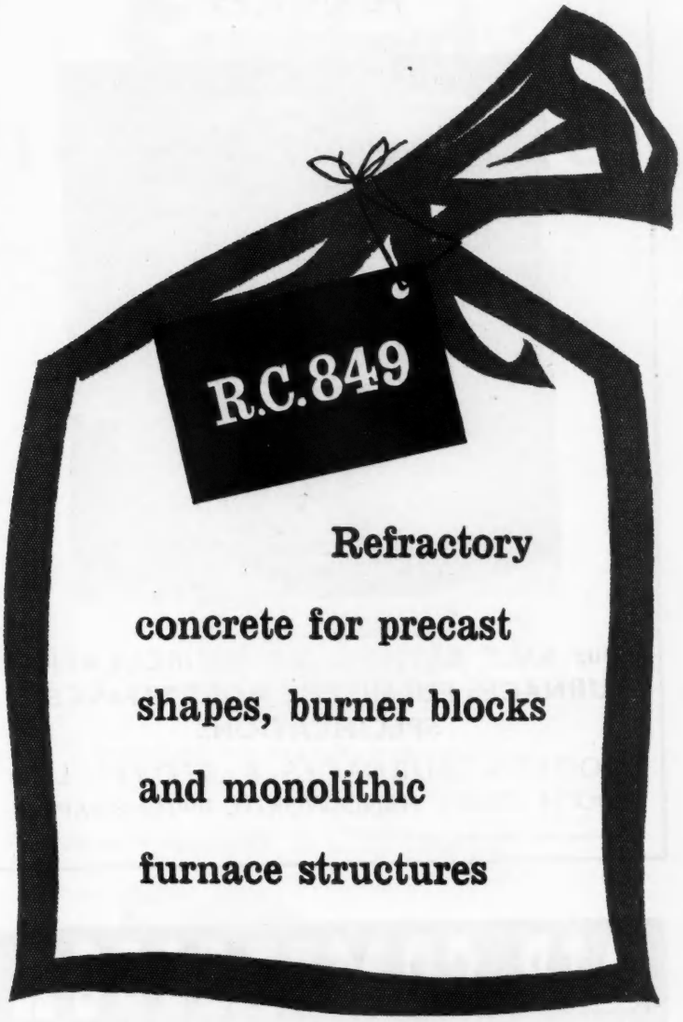

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After firing at 1350°C ...	120 lb/cu. ft.
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After firing at 1350°C	4480 lb/sq. in.
Refractoriness	Cone 19 (1520°C)
After-contraction	Not measurable after firing at 1350°C.

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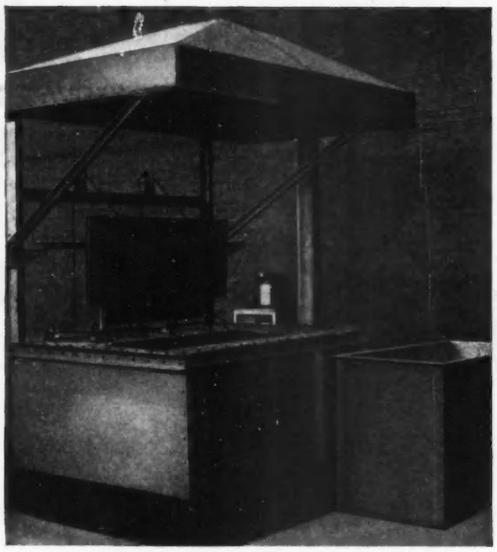

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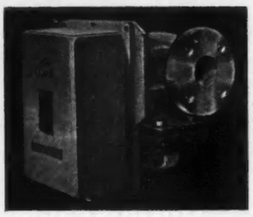

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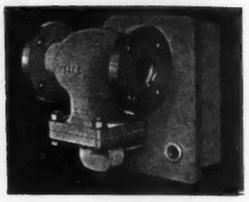

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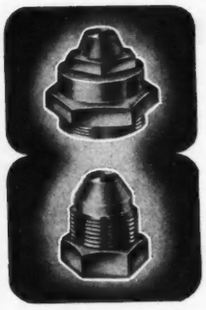

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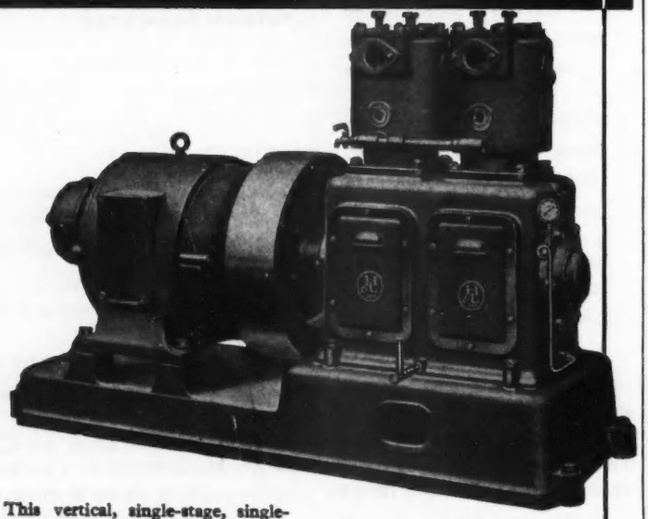

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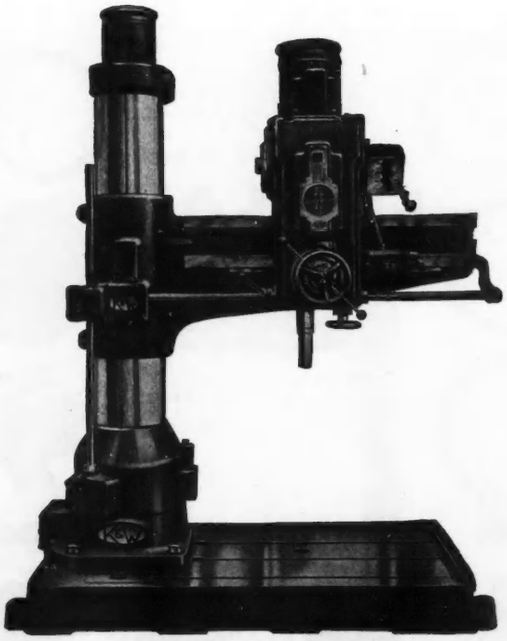

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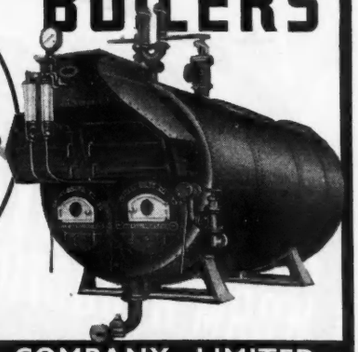

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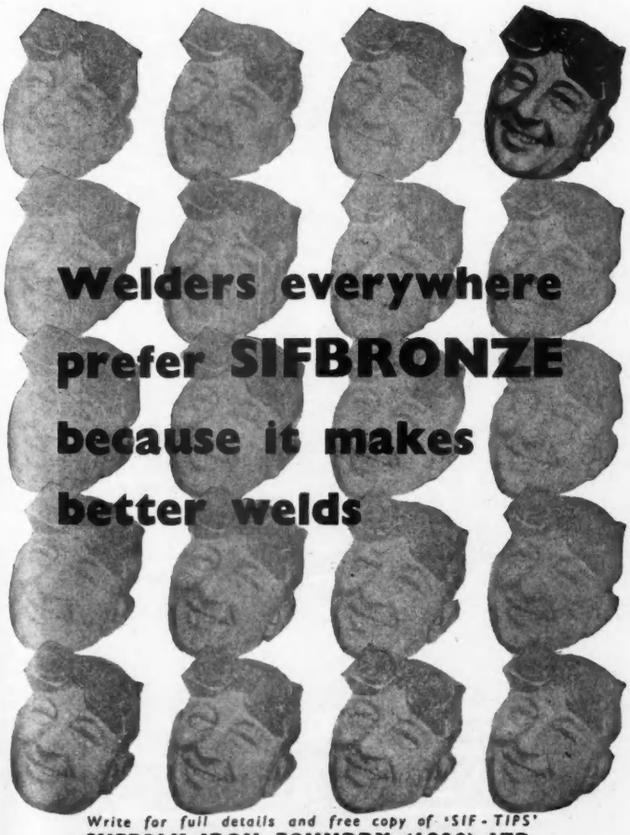

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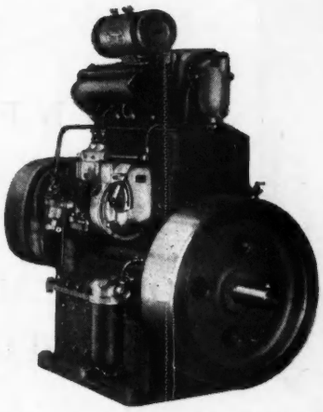

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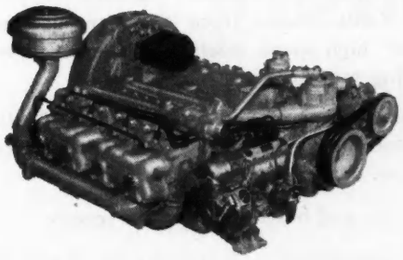

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Stroke	—	5·25 inches
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B.H.P. Max.	—	65
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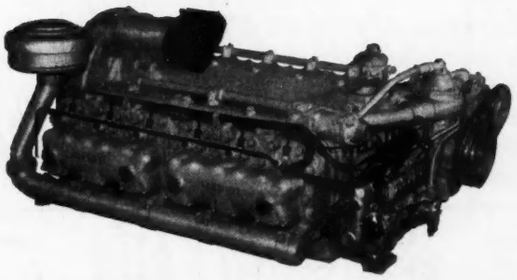

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Engine Type	—	6.D
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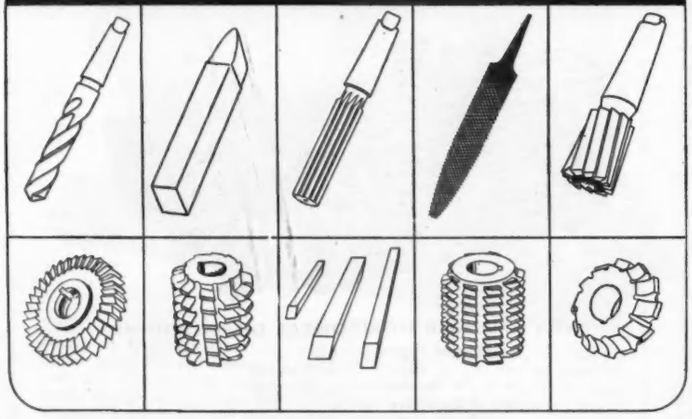

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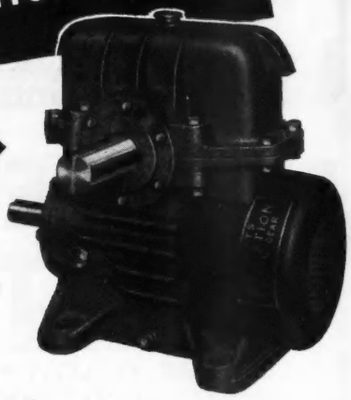

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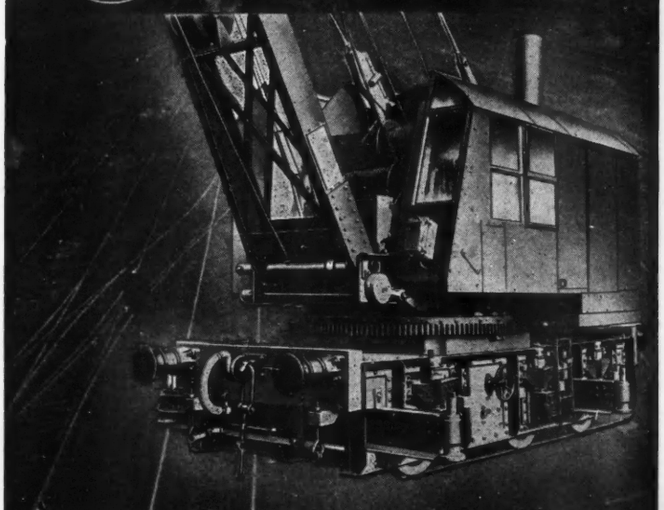

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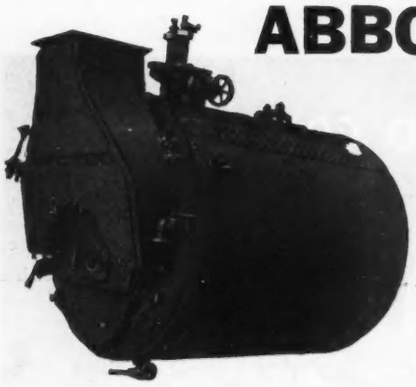

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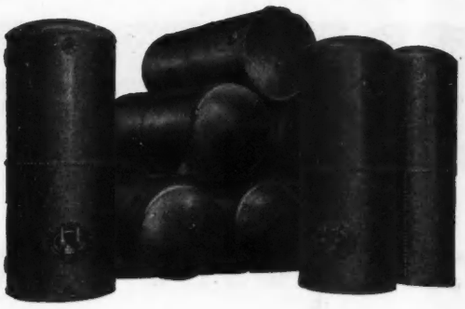

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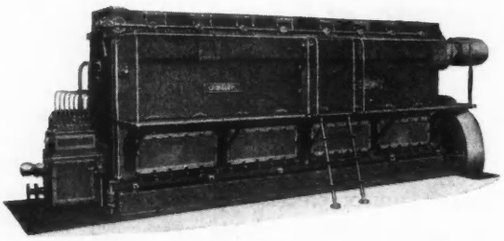

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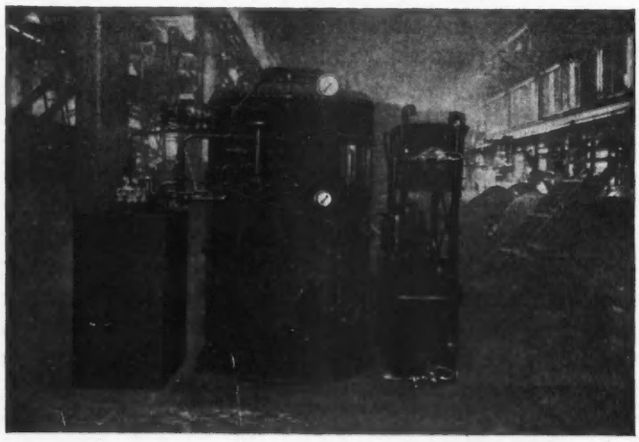

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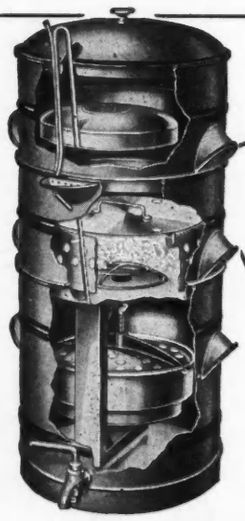

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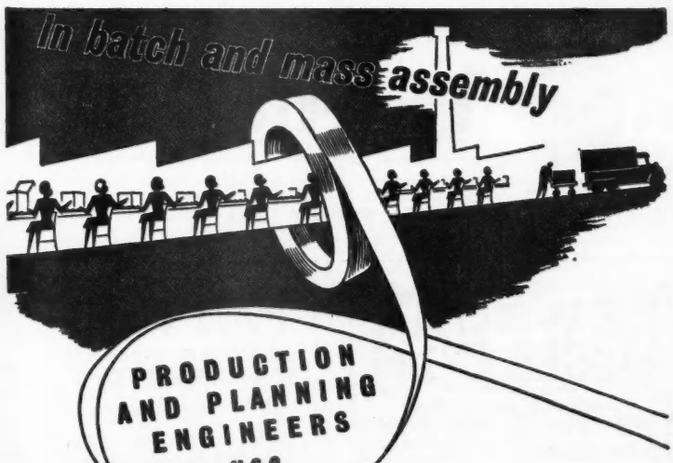

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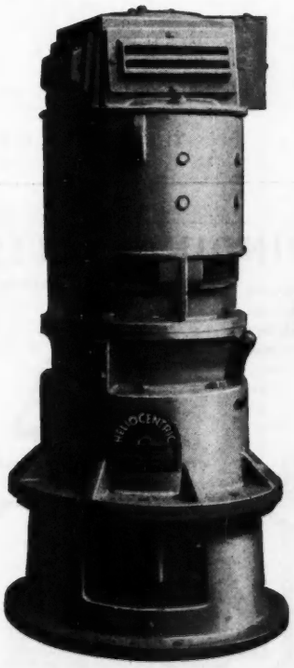

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The photograph shows large vertical drive Heliocentric Speed Reducers specially made for pile screwing equipment in Turkey for Messrs Braithwaite & Co. Engineers Limited, Crown Bridge Works, West Bromwich, with 15 h.p. motors and reduction ratios of 60:1. Standard Heliocentric Motorised Reducers are available in ratios from 20:1 to 512,000:1, ¼ h.p. to 30 h.p. Types of mounting for all conditions and all angles.

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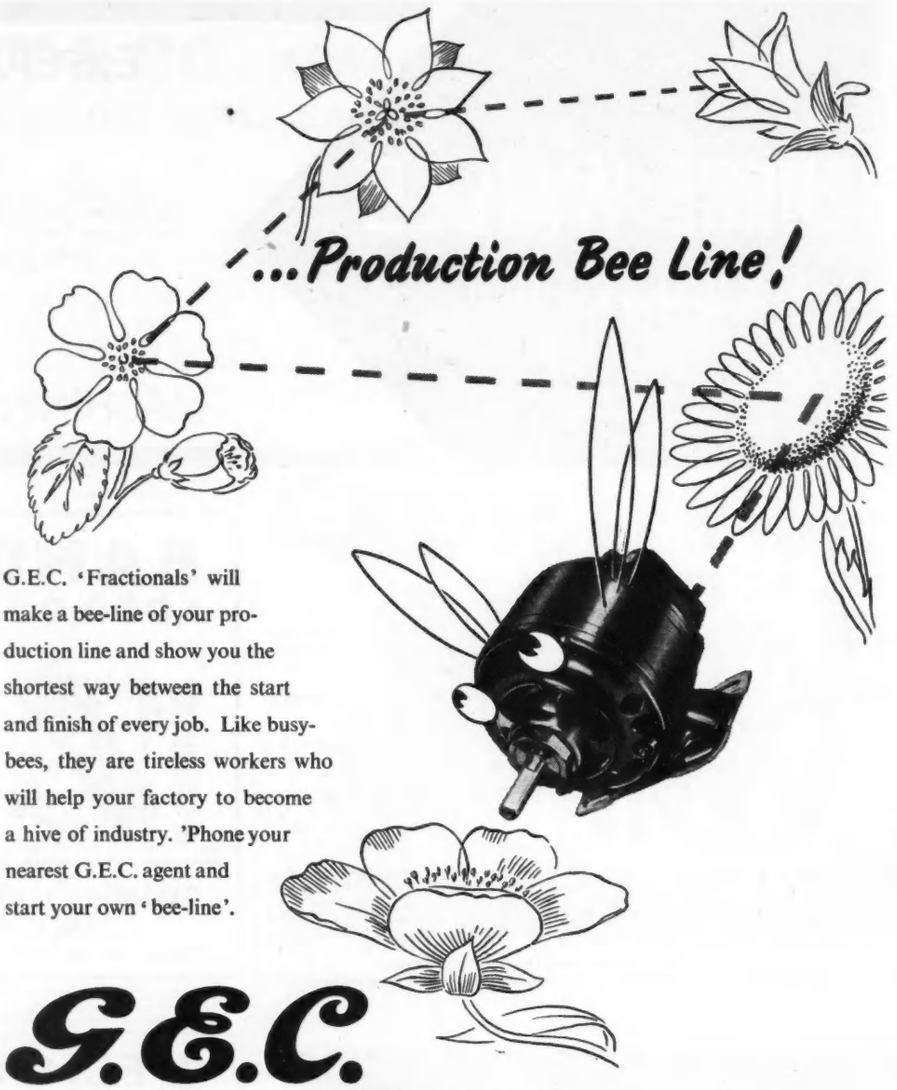

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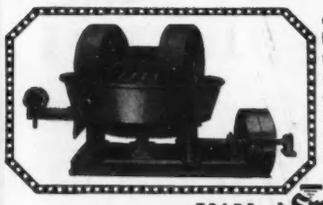

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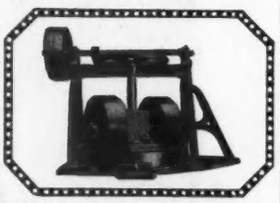

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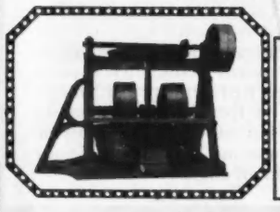

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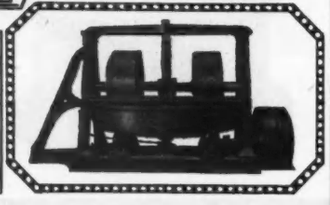

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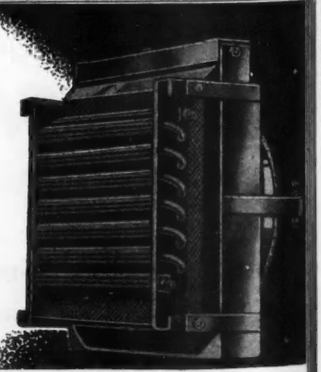

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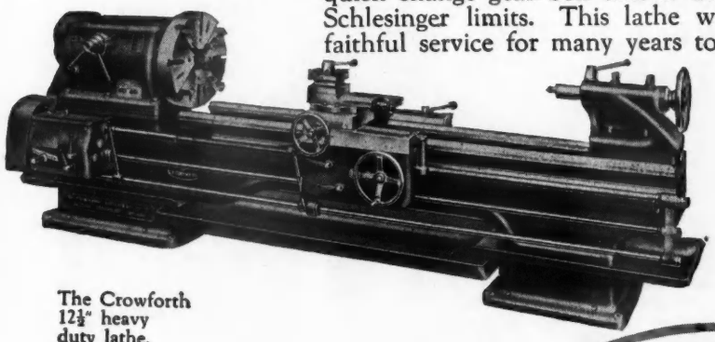

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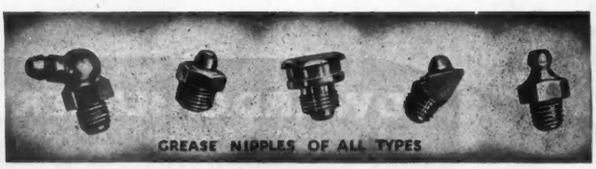

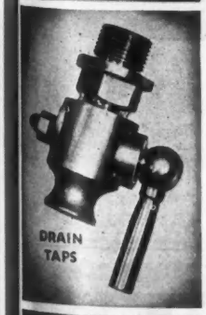

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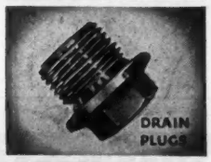

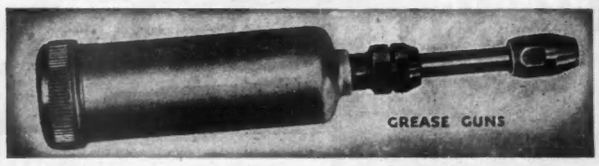

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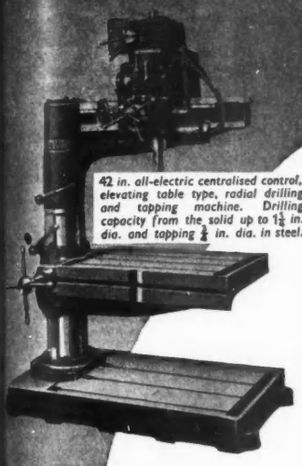

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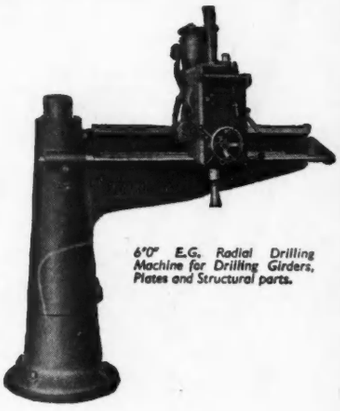

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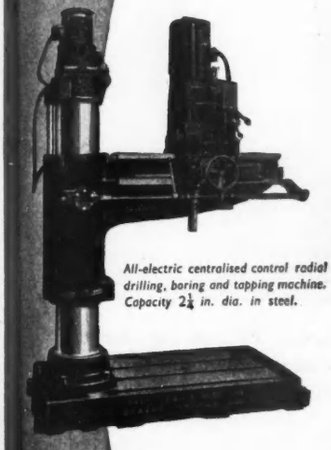

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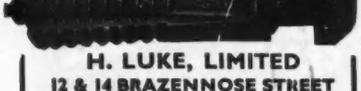

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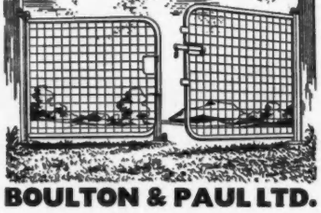

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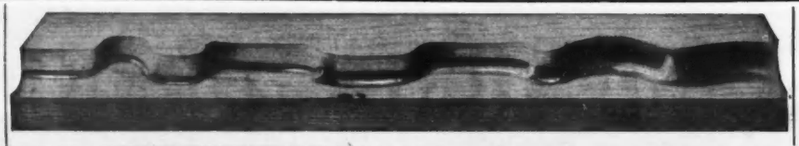

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The equipment will need to be dismantled and removed from site by the successful tenderer within one calendar month of the acceptance of the tender. The equipment is situated at Electricity Works, Gordon Road, Haywards Heath, and arrangements to inspect can be made with the Board's District Manager, Church Road, Haywards Heath, Telephone No. Haywards Heath 1500.
Tenders to reach me by 6th July, 1953, must be enclosed in envelopes complying with the following conditions:—
(i) Addressed to—
A. L. BURNELL, ESQ.,
SECRETARY,
SEEBoard,
10, Queen's Gardens,
Hove 3, Sussex.
(ii) Endorsed "TENDER FOR CRANE."
(iii) Bear no indication of name or address of tenderer.
The Board does not undertake to accept the highest or any tender received.
A. L. BURNELL,
Secretary. R 455

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COMPRESSOR, water cooled, two stage, heavy duty, displacement 1000 cub. ft. of free air per min. to deliver at 100 lb. per sq. in with "V" belt motor drive, suitable for 400-440 volts, 3 phase, 50 cycles, A.C. supply, complete with electric motor, starter, intercooler, receiver, air filter and spares. Make: Ingersoll Rand, class XLE, 18½ in. by 11½ in. by 8½ in., or similar.
Forms of tender, which are returnable by FRIDAY 31st JULY, 1953, may be purchased at the above address, on or after Thursday, 25th June, 1953, at a cost of 10s.
In your application for tender forms, please quote Reference D.O. 2405/52. R 520

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WILLIAM KERR,
Town Clerk.
City Chambers,
Glasgow, C.2. R 447

PUBLIC APPOINTMENTS.

GOVERNMENT OF KUWAIT.

ELECTRICAL MAINTENANCE ENGINEER required for service with the Government of Kuwait, Persian Gulf. Applicants, preferably not more than 35 years of age, should have some technical qualifications and good electrical engineering training and subsequent experience with switchgear and the various protective relays, transformers, cabling and electrical machinery. Steam and power plant, and diesel plant operating experience would be an advantage. The starting consolidated salary offered is at the rate of £1500 to £1600 per annum according to qualifications and experience. Free furnished quarters and free medical attention are provided or an allowance in lieu thereof. The first year will be probationary and, if satisfactory, home leave will be granted at the end of three years' complete service. Married accommodation cannot be promised within one year.—Applications, stating age and giving full details of qualifications and experience, should, in the first instance, be addressed to THE SECRETARY, EWBANK & PARTNERS, LIMITED, 10/11, Grosvenor Place, London, S.W.1. R 340

RIVER WEAR COMMISSIONERS.

PORT OF SUNDERLAND.

A vacancy will shortly occur in the established staff of the Engineering Department for the position described hereunder. Applications are invited from **QUALIFIED CIVIL ENGINEERS,** preferably with harbour and dock experience, but this is not essential. The appointment will be subject to the provisions of the Local Government Superannuation Act, 1937, and the successful candidate will be required to pass a medical examination.

SENIOR ASSISTANT ENGINEER in the Drawing Office. Salary in accordance with Grade APT. VIII (£760 to £835 per annum), starting point to be according to age and experience.

Applications, stating age, qualifications and experience and accompanied by copies of testimonials, should be addressed to the undersigned and received NOT LATER THAN 18th JULY, 1953.
R. S. COGDON,
Engineer.
River Wear Commissioners,
St. Thomas Street, Sunderland,
Co. Durham. R 381

Applications are invited for the position of **ASSISTANT PROFESSOR, DEPARTMENT OF CIVIL ENGINEERING,** UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, CANADA. Candidates should have had post-graduate training preferably at the Ph.D. level in fluid mechanics. Duties include teaching fluid mechanics, soil mechanics or other courses in the undergraduate school and teaching one post-graduate course in some phase of fluid mechanics. Starting salary is $4200 per year with the possibility of augmenting income with summer work on hydraulic models or other hydraulic projects. Applications should be received by JULY 15, 1953. R 458

COLLEGE OF TECHNOLOGY, BIRMINGHAM.

HEAD OF DEPARTMENT OF MECHANICAL ENGINEERING.

REVISED ADVERTISEMENT.

Applications are invited for the above post, which is to be filled as soon as possible. Applicants should possess, in addition to appropriate academic and teaching experience, also industrial and research experience.
Salary will be £1490 by £25 to £1790 and the post will be graded in accordance with the Burnham (Further Education) Report as a Grade V Headship.
Forms of application and details and duties of the post may be obtained from THE REGISTRAR, COLLEGE OF TECHNOLOGY, Suffolk Street, Birmingham, 1.
Closing date for applications is 20th JULY, 1953.
C. McCAW,
Clerk to the Governing Body. R 469

THE UNIVERSITY OF LEEDS.

DEPARTMENT OF MINING.

The Council invites applications for a **RESEARCH ASSISTANT** to work on fluid mechanics, hydraulic transport of coal, etc., either in the Department's research laboratories or, where necessary, at the Mines—candidates should hold a good Honours Degree in Mining or in Civil or Mechanical Engineering. The salary will be up to £450 a year, according to qualifications and experience.—Applications (four copies) stating age, qualifications and experience, together with the names of two referees, should reach the REGISTRAR, THE UNIVERSITY, Leeds, 2 (from whom further particulars may be obtained) not later than 17th JULY, 1953. R 471

BRITISH ELECTRICITY AUTHORITY, NORTH WESTERN DIVISION, requires
MAINTENANCE ENGINEER (MECHANICAL) at new Chadderton H.P. Generating Station, near Oldham. Salary £787-£818 per annum. Mechanical engineering qualifications and experience of operation and maintenance of power plant required.—Apply, quoting Vacancy No. 138/53, to ESTABLISHMENTS OFFICER, British Electricity House, 825, Wilmslow Road, Manchester, 20, BEFORE 11th JULY. R 491

MARINE DEPARTMENT—NEW ZEALAND.

Applications are invited from suitably qualified persons to fill the vacancy for a **SENIOR SURVEYOR** in the **HEAD OFFICE OF THE MARINE DEPARTMENT AT WELLINGTON.** Commencing salary up to £1130 N.Z. per annum, according to qualifications and experience.
Applicants should have the following professional qualifications:—
(1) An Extra First Class Marine Engineer's Certificate, or
(2) Associate Membership (by examination) of the Institution of Mechanical Engineers, or
(3) A University degree in mechanical engineering or engineering science, or other equivalent voucher of scholarship.
In addition, applicants should have had experience as follows:—
(*a*) Sea service as engineer officers either in the Merchant Navy or in the Royal Navy, or
(*b*) Experience as Ship Surveyors or Engineer and Ship Surveyors of a ship survey authority.
(*c*) Equivalent experience and responsibility in mechanical engineering and/or naval architecture.
Application forms, together with conditions of appointment, may be obtained from the HIGH COMMISSIONER FOR NEW ZEALAND, 415, Strand, London, W.C.2, mentioning this paper and quoting reference A3/105/2.
Completed applications in duplicate to be lodged NOT LATER THAN 11th JULY, 1953. R 428

SUDAN GOVERNMENT.

The Public Works Department requires an **ASSISTANT DIRECTOR** for service in the Sudan. Candidates should have extensive experience in the building branch of a Public Works Department, preferably under Middle East or North African conditions. Either Architect or Engineer acceptable, preferably with previous experience as Head of department. Corporate Membership R.I.B.A. or Institution of Civil Engineers or equivalent desirable. The duties will be to take charge of the administration of the building side of the P.W.D., responsibility for building programmes, housing, medical and educational buildings totalling about £E.1½ million yearly. Considerable touring involved by Government air service.
Appointment will be on Short Term Contract (with bonus) determinable at any time by six months' notice from either side at a salary of £E.2500 per annum fixed rate. A variable cost-of-living allowance is now payable in the Sudan and is reviewed quarterly. No Income Tax is at present payable in the Sudan. Annual home leave on a generous scale after initial tour of approximately 18 months. Free passages by air both ways for official and family. Duty transport provided. Government accommodation, as available, provided at low rent. An outfit allowance of £E.50 is payable when contract is signed.
Further information and application form will be sent on receipt of a post card only addressed to the SUDAN AGENT IN LONDON, Sudan House, Cleveland Row, London, S.W.1, quoting name and address in BLOCK LETTERS and "Assistant Director 1825." R 489

CITY OF BATH TECHNICAL COLLEGE.
Principal: H. B. TOFT, B.Sc.

Required for September 1st, 1953:—
1. FULL-TIME ASSISTANT (GRADE A) in Mechanical Engineering to teach to Ordinary National Certificate and Final City and Guilds standards: Engineering Drawing, Workshop Technology, and Mechanical Engineering Science. An opportunity for more advanced work may be given to a suitable applicant.
2. FULL-TIME ASSISTANT (GRADE A) to teach, mainly, the Theory and Practice of Workshop Technology to Final City and Guilds standard, but willing also to take some classes in Elementary Mathematics and Drawing.
SALARY: Burnham Technical Scale (£415 by £18 to £670). The commencing salary will depend upon training, and teaching and industrial experience. The post is subject to the Teachers Superannuation Regulations.
Application forms and further particulars from the PRINCIPAL, Technical College, Lower Borough Walls, Bath. R 449

SURREY EDUCATION COMMITTEE.

KINGSTON-ON-THAMES TECHNICAL COLLEGE,
KINGSTON HALL ROAD,
KINGSTON-ON-THAMES.

Applications are invited for the post of **FULL-TIME TEACHER** of **MECHANICAL ENGINEERING** subjects for the full-time Diploma and part-time National Certificate Courses, in the Engineering Department.
Candidates should possess a degree in Mechanical Engineering and/or an equivalent qualification, and should preferably have good experience in industry. Previous teaching experience, either full-time or part-time, will also be an added advantage.
Salary in accordance with the Burnham Technical Scale 1951 for Assistants Grade A (Men, £415 × £18 to £670 p.a.). If the qualifications and experience of the successful candidate are sufficiently high, consideration may be given to an appointment on Grade B.
Forms of application, together with particulars of the appointment, may be obtained from the Principal to whom they should be returned WITHIN TWO WEEKS of the appearance of this advertisement. R 430

LINDSEY COUNTY COUNCIL
EDUCATION COMMITTEE.

GAINSBOROUGH COUNTY TECHNICAL COLLEGE.

APPOINTMENT OF PRINCIPAL.

Applications are invited for the post of **PRINCIPAL OF THE GAINSBOROUGH TECHNICAL COLLEGE.** Candidates should possess a university degree and good qualifications in engineering. An interest in the development of other forms of further education will be an additional recommendation. Salary subject to the approval of the Ministry of Education, will be at the rate of £1040 rising by annual increments of £50 to a maximum of £1290.
Further particulars and forms of application may be obtained FROM THE UNDERSIGNED, to whom completed applications must be returned NOT LATER THAN TWO WEEKS after the publication of this advertisement.
F. J. BIRKBECK,
Director of Education.
County Offices,
Lincoln. R 440

GOVERNMENT OF QATAR.
(PERSIAN GULF).

ELECTRIFICATION OF DOHA.

POWER STATION ENGINEER.

Applications are invited for the above appointment. Candidates must have served a mechanical engineering apprenticeship, and have considerable practical experience of the erection, operation and maintenance of diesel engine alternator sets and ancillary equipment, H.V. and L.V. switchgear, and be capable of training local labour. A knowledge of cable and overhead line work would be an advantage.
Salary £140 to £150 per Arabic month according to qualifications and experience, payable in Rupees (Rs. = 1s. 6d.), and is at present free of tax.
Appointments are for a period of five years, terminable by three months' notice on either side.
Free air passages are provided for the officer and his family on first appointment, on termination of agreement and for leave to the United Kingdom.
Free quarters with heavy furnishings, water and light, and medical attention will be provided.
Leave is earned at the rate of 90 days per year of resident service and may be accumulated. Earned leave to the United Kingdom may be taken after 18 months of service.
A knowledge of Arabic would be an advantage. Applications endorsed "POWER STATION ENGINEER, QATAR," stating age, qualifications and experience, should be forwarded within 21 days of the date of this advertisement to the undersigned, who will communicate with candidates selected for further consideration.
PREECE, CARDEW & RIDDER,
8-10, Queen Anne's Gate,
Westminster, London, S.W.1. R 465

ROYAL NAVAL COLLEGE,
GREENWICH, LONDON, S.E.10.

LECTURER IN PHYSICS AND ELECTRICAL ENGINEERING DEPARTMENT.

Applications are invited for appointment in SEPTEMBER, 1953, or as soon after as possible.
The post is open to men only who must be British subjects and should have a 1st or 2nd Class Honours Degree in Physics or Electrical Engineering or equivalent qualifications. Familiarity with the design of electrical machinery is essential. Experience in electronics, electrical engineering practice or radio engineering is desirable.
Appointment will be as Junior Lecturer (salary £400-£650) or as Senior Lecturer (£750-£950) according to age, qualifications and experience. A pay addition (approximately 10 per cent. of the first £500 of salary and 5 per cent. of balance) will also be allowable. In certain circumstances, a starting salary above the minimum may be authorised. Advancement to higher posts is possible. Consideration would be given to secondment for agreed period of serving member of Scientific Civil Service. Letters of application accompanied by names of three referees and statement of qualifications and previous experience to be sent as soon as possible to DIRECTOR OF STUDIES, R.N. COLLEGE, Greenwich, S.E.10, from whom further particulars may be obtained. Closing date for applications is 4th JULY, 1953. R 503

Appointments Open continued on Page 84

Public Appointments continued from Page 83

BRITISH ELECTRICITY AUTHORITY.
SOUTH EASTERN DIVISION.

JUNIOR ENGINEER (CONTROL), Croydon "B" Power Station. Applicants should preferably possess educational qualifications equivalent to Higher National Certificate and should have had experience in the operation of E.H.T. switchgear and parallel running of alternators. Class J, Grades 18/14 commencing at £427 per annum including London Allowance. N.J.B. Conditions of Service.

Applications, giving details of present position, education, experience, etc., should be received by STATION SUPERINTENDENT, CROYDON "B" POWER STATION, Beddington Farm Lane, Purley Way, Croydon, Surrey, not later than 4th JULY. R 490

COUNTY BOROUGH OF BOLTON,
EDUCATION COMMITTEE.

BOLTON TECHNICAL COLLEGE.

Applications are invited for the post of **HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT,** to take up duties as soon as possible. Applicants should be well qualified in engineering and allied subjects, and have had industrial and teaching experience.

Facilities for research are available, and development in this field is desirable.

The Department is a Grade III Department, and salary will be in accordance with the appropriate scale of the Burnham Scales of Salaries for Teachers in Institutions for Further Education, viz.: £1190 by £25 to £1340 per annum.

Application forms and further particulars may be obtained from the undersigned to whom completed applications should be returned not later than 14 days after the appearance of this advertisement.

W. T. SELLEY,
Education Offices, Chief Education Officer.
Nelson Square,
Bolton. R 466

THE UNIVERSITY OF LIVERPOOL.

Applications are invited for the post of **LECTURER IN THE DEPARTMENT OF MECHANICAL ENGINEERING.** The initial salary will be within the range £550-£800 per annum according to qualifications and experience.

Applications, stating age, academic qualifications and experience, together with the names of three referees, should be received NOT LATER THAN 18th JULY, 1953, by the undersigned, from whom further particulars of the conditions of appointment may be obtained.

STANLEY DUMBELL,
Registrar. R 498

SENIOR SCIENTIFIC OFFICERS; SCIENTIFIC OFFICERS; PATENT EXAMINER AND PATENT OFFICER CLASSES. The Civil Service Commissioners invite applications for permanent and pensionable appointments to be filled by competitive interview during 1953. Interviews will continue throughout the year, but a closing date for the receipt of applications earlier than December, 1953, may eventually be announced. The Scientific posts are in various Government Departments and cover a wide range of Scientific Research and Development in most of the major fields of fundamental and applied science; in Biology the number of vacancies is small. The Patent posts are in the Patent Office (Board of Trade), Admiralty and Ministry of Supply.

Candidates must have obtained a university degree with first or second class honours in an appropriate scientific subject (including engineering) or in Mathematics, or an equivalent qualification; or for Scientific posts, possess high professional attainments. Candidates for Senior Scientific Officer posts must in addition have had at least three years' post-graduate or other approved experience. Candidates for Scientific Officer and Patent posts taking their degrees in 1953 may be admitted to compete before the result of their degree examination is known.

AGE LIMITS: Senior Scientific Officers, between 26 and 31; for Scientific Officers and Patent Classes, between 21 and 28 during 1953 (up to 31 for permanent members of the Experimental Officer class competing as Scientific Officers). London Salary Scales: Senior Scientific Officers, (men) £812-£1022; (women) £681-£917; Scientific Officers, (men) £440-£707; (women) £440-£576; Patent Examiner and Patent Officer Classes (men) £440-£655; (women) £440-£576. Somewhat lower rates in the provinces.

Further particulars from the CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, Trinidad House, Old Burlington Street, London, W.1, quoting No. S.53/53 for Senior Scientific Officers and S.52/53 and S.128/53 for the other posts. R 501

ELECTRICAL ENGINEER required by DIVISION OF ATOMIC ENERGY (PRODUCTION) for design and specification of electrical equipment for large factories including H.T. and L.T. switchgear, substations and internal installations. Qualifications: recognised electrical engineering apprenticeship with A.M.I.E.E. (or equivalent) and experience of factory installations. Salary £597 (at age 25)-£927. Voluntary superannuation.—Applications to MINISTRY OF SUPPLY, D.A.T.EN.(P) Risley, Warrington, quoting 470. R 502

DESIGN ENGINEERS required by DIVISION OF ATOMIC ENERGY (PRODUCTION) to undertake duties of project engineers, including the design and layout of special plant and equipment. Qualifications: recognised engineering apprenticeship with A.M.I.Mech.E. (or equivalent). Experience of special-purpose machinery or chemical plant design essential. Salary ranges: £1256-£1454, or £927-£1218, according to qualifications and experience. Voluntary superannuation. Houses in reasonable time, if married.—Applications to MINISTRY OF SUPPLY, D.A.T.EN.(P), Risley, Warrington, quoting 469. Recent candidates need not apply again. R 505

AMENDED.

EXPERIMENTAL OFFICERS AND ASSISTANT EXPERIMENTAL OFFICERS in various Government Departments. The Civil Service Commissioners invite applications for pensionable posts. Applications may be accepted up to 31st December, 1953, but an earlier closing date may be announced either for the competition as a whole or in one or more subjects. Interviews will generally be held shortly after the receipt of the completed application form.

The posts are divided between the following main groups and subjects: (*a*) Mathematical and Physical Sciences (*b*) Chemistry and Metallurgy (*c*) Biological Sciences (*d*) Engineering subjects, and (*e*) Miscellaneous (including, e.g., Geology, Library and Technical Information Services).

AGE LIMITS: For Experimental Officers, at least 26 and under 31 on 31st December, 1953; for Assistant Experimental Officers at least 18 and under 28 on 31st December, 1953. Extension for regular service in H.M. Forces.

Candidates must have at least one of a number of specified qualifications. Examples are Higher School Certificate, General Certificate of Education, Scottish Leaving Certificate, Scottish Universities Preliminary Examination, Northern Ireland Senior Certificate (all in appropriate subjects and at appropriate levels), Higher National Certificate, University degree. Candidates taking their examinations in 1953 may be admitted. Candidates without such qualifications may be admitted exceptionally on evidence of suitable experience. In general, a higher standard of qualification will be looked for in the older candidates than in the younger ones.

Inclusive London salary scales: Experimental Officer £681-£838 (men); £586-£707 (women). Assistant Experimental Officer £274-£607 (men); £274-£511 (women). Starting pay according to age up to 26. At 18, £274; at 26, £495 (men), £467 (women). Somewhat lower in provinces.

Further particulars and application forms from CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, Trinidad House, Old Burlington Street, London, W.1, quoting No. S94-95/53. Completed application forms should be returned as soon as possible. R 506

ENGINEER, GRADE I (reference 467) and **ENGINEERS, GRADES II AND III** (reference 468) required by DIVISION OF ATOMIC ENERGY (PRODUCTION) for work on major calculations required by design office concerned with nuclear reactors and factories for producing fissile material. Subjects dealt with relate to fluid flow, heat transfer, nuclear radiation shielding and stress analysis, and cover such items as pumps, compressors, bearings and heat exchangers. The Engineer, Grade I, will be responsible for a small specialist staff and should have extensive engineering experience. Qualifications for all posts: recognised engineering apprenticeship with A.M.I.Mech.E., and experience of type of duties noted. Salary ranges: Grade I, £1256-£1454, II £927-£1218, III £597 (at age 25)-£927, according to age, qualifications and experience. Voluntary superannuation. Houses in reasonable time, if married.—Applications to MINISTRY OF SUPPLY, D.A.T.EN.(P), Risley, Warrington, quoting reference of post applied for. R 504

CITY OF BIRMINGHAM EDUCATION COMMITTEE.

GARRETTS GREEN BRANCH TECHNICAL COLLEGE.

GARRETTS GREEN LANE, BIRMINGHAM, 33.
Principal: B. C. WHITEHOUSE, B.Sc., A.R.I.C.

Applications are invited for a **FULL-TIME POST OF ASSISTANT, GRADE B, IN ELECTRICAL ENGINEERING** at this new Branch Technical College opening in September.

The person appointed will be required to take Ordinary National Certificate work in Electrical Engineering, including the ancillary subjects of Mathematics and Engineering Science. He will also be required to assist with subjects of the City and Guilds Electrical Installation course especially Electro-technology. Ability to assist with the City and Guilds Radio Service and Telecommunications courses would be an advantage.

Salary in accordance with the Burnham (Further Education) Scale for Assistants, Grade B, £490 by £25 to £765 (men), with additions for graduate or equivalent qualification and training where applicable. In fixing the commencing salary allowance would be made for teaching and approved industrial experience.

Further particulars and application form may be obtained from THE PRINCIPAL, to whom completed applications should be returned WITHIN TWO WEEKS of the appearance of this advertisement.

E. L. RUSSELL,
Chief Education Officer. R 509

DERBYSHIRE EDUCATION COMMITTEE.

CHESTERFIELD COLLEGE OF TECHNOLOGY.

Principal: E. CARDWELL, M.Sc.(Lond.), Wh.Ex., M.I.Mech.E.

Applications are invited for the full-time appointment of **ASSISTANT, GRADE B, IN THE DEPARTMENT OF MECHANICAL AND CIVIL ENGINEERING.** Duties will commence on the 1st SEPTEMBER, 1953, or as soon thereafter as possible.

The successful candidate will be required to teach Production Engineering subjects up to the standard of the Higher National Certificate and the Final Examination of the City and Guilds of London Institute. Good industrial experience, including shops and drawing office, is essential, and teaching experience would be an advantage.

Salary will be in accordance with the Burnham Technical Scale for Assistants, Grade B, i.e., £490-£765, with additions for Graduate status and training. Appropriate industrial service and teaching experience will be taken into account in determining the commencing salary.

Further particulars and forms of application may be obtained from the undersigned (stamped addressed foolscap envelope required) to whom applications should be returned by the 11th JULY, 1953.

S. A. BROADWELL,
Registrar. R 514

College of Technology,
Infirmary Road, Chesterfield.

Applications are invited for post of **COAL PREPARATION PLANT MANAGER,** Lynemouth Colliery, Northumberland. The plant will have a capacity of 800 tons per hour and will include heavy density washing, Baum washer boxes and Froth Flotation equipment. Applicants should possess an Engineering qualification and must have had considerable experience in the practical operation of Coal Preparation Plants. Salary according to qualifications and experience.

Applications, giving date of birth and full details of qualifications, experience, etc., to be addressed NOT LATER THAN 9th JULY, 1953, to AREA ADMINISTRATIVE OFFICER, Area No. 3, National Coal Board, Northern (N. & C.) Division, Colliery Offices, Ashington, Northumberland. R 518

BRITISH ELECTRICITY AUTHORITY, Headquarters, London, require a **SENIOR ASSISTANT CIVIL ENGINEER** in the Transmission Construction Branch. Candidates should preferably be Corporate Members of the Institution of Civil Engineers or hold a University Degree in Civil Engineering. Duties are concerned with the design and construction of high voltage transforming and switching stations in connection with the establishment of the 275-kV Grid and extension of the 132-kV Grid. Salary N.J.B. Grade 1, £1002-£1378 inclusive.—Applications stating age, present position and salary, qualifications and experience, to D. MOFFAT, DIRECTOR OF ESTABLISHMENTS, Winsley Street, London, W.1, by 13th JULY, 1953. Quote reference ENG/389. R 526

THE COLLEGE OF AERONAUTICS.

A vacancy for a **DEMONSTRATOR** exists in the **DEPARTMENT OF AIRCRAFT PROPULSION.** He will be primarily responsible for the preparation and supervision of students' experimental work, but will also be required to assist in research. Candidates should preferably have a degree, and some ability in the experimental testing of rockets, ram jets, gas turbine combustion chambers, or other aspects of modern power plants. The salary will be on a scale rising to £750 per annum, with superannuation under F.S.S.U. and family allowance. Initial salary will depend upon age and qualifications.—Applications, giving full particulars of experience and qualifications and containing names and addresses of not more than three referees, to the RECORDER, THE COLLEGE OF AERONAUTICS, Cranfield, Bletchley, Bucks. Further particulars available on application. R 524

TECHNICIAN (TELEPRINTER MAINTENANCE) required for NORTHERN RHODESIA GOVERNMENT Posts and Telegraphs Department for tours of 3 years in first instance with prospect of permanency. Salary, etc., in scale £651 rising to £1103 a year. Free passages. Liberal leave on full salary. Candidates should possess G. and Gds. Certs. in Tellecoms. and have had 5 years' training in Post Office workshops or a similar apprenticeship. Experience should include maintenance of Creed Teleprinters, V.F. Telegraph System, and preferably 3- and 12-channel carrier equipment, the Strowger type of automatic equipment and Telecoms. practice. G.P.O. Staff should apply through their department.—Write to the CROWN AGENTS, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/29951/ET. R 525

APPOINTMENTS OPEN.

THE ENGAGEMENT OF PERSONS answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

It is advisable when sending testimonials to forward copies and NOT originals.

SALES ENGINEER required with high technical qualifications and first-class connections with steel works and large industrial concerns. Must be able to advise potential customers concerning plant installations and follow up enquiries to conclusion.—Applications in writing to give age, qualifications, experience and salary required, to BOX B 368, Offices of ENGINEERING.

ASSISTANT MECHANICAL ENGINEER required by KUWAIT OIL COMPANY, LIMITED, in their London Office for the initial development of gas oil production equipment and the technical scrutiny of indents and orders. Must be A.M.I.Mech.E. or possess degree in mechanical engineering together with thorough knowledge of drawing office routine and some design experience. Age 30-35. Salary according to experience and qualifications but starting not less than £850 p.a. if qualified. Non-contributory Pension Scheme and luncheon vouchers.—Write for application form giving brief details to Box Y/139, c/o 191, Gresham House, E.C.2. R 417

DRAUGHTSMAN required to take charge of small Drawing Office. Must be conversant with lift and crane work. Age not important, although under 50 preferred. Possibility of house in the locality in the near future for suitable man.—Apply: VAUGHAN LIFT ENGINEERING, LTD., 5, Crompton Way, Crawley, Sussex. G 210

PETER BROTHERHOOD, LTD., Peterborough, require **DRAUGHTSMEN (SENIOR AND JUNIOR),** preferably with experience in design of compressors, turbines and steam engines. Permanent positions, five-day week, staff pension scheme.—Write, giving full details, age, experience and salary required. Z 426

Applications are invited from **DESIGN DRAUGHTSMEN AND STRESSMEN,** also **TECHNICAL ASSISTANTS** with combined design and performance experience for work on both reciprocating and gas turbine aero-engines.—Applications should state full particulars of experience and qualifications and should be addressed to the PERSONNEL OFFICER, THE DE HAVILLAND ENGINE CO., LTD., Stag Lane, Edgware, Middlesex. G 117

Applications are invited from **SENIOR AND INTERMEDIATE DESIGN DRAUGHTSMEN;** experience of aero engine design desirable but not essential, also Checkers.—Please write, stating age and giving details of previous experience in chronological order to the PERSONNEL OFFICER, THE DE HAVILLAND ENGINE CO., LTD., Stag Lane, Edgware, Middlesex. G 121

FRASER & CHALMERS
ENGINEERING WORKS,
ERITH,
KENT

have vacancies for

Senior
DRAUGHTSMEN

Applications are invited from men, preferably with some experience of Coal Washing Plant, but applicants with Material Handling Plant Layout, Structural or Piping experience will be considered. Good salaries according to experience and ability.

Pension Scheme and good working conditions.
Apply, giving full details of experience, to:—

PERSONNEL MANAGER (REF. C.P.D.),

Fraser & Chalmers Engineering Works,

Erith, Kent.

R 515

ASSISTANT ENGINEER, MAINTENANCE. A large Chemical Manufacturing Company in the London area requires an Assistant Engineer who would be responsible to the Chief Works Engineer for Maintenance and modification of operating plant. Candidates must possess as a minimum, qualifications granting exemption from Sections A and B of the Examinations of the Institution of Mechanical Engineers and have had several years' industrial experience, preferably in a similar capacity. Preferred age range 28-35. This is a permanent appointment with good prospects. A Pension Scheme is in force. Salary in accordance with experience and qualifications.—Apply with full details to BOX R 499, Offices of ENGINEERING.

Applications are invited for the following vacancies on the Aden Refinery Project.

ENGINEER SURVEYORS. University graduates (civil engineering preferred) or A.M.I.C.E. Minimum of 6 years' experience in industrial or refinery plant layout, sewers and buildings. Able to handle survey party.

ENGINEERING INSPECTORS. Must have extensive practical experience in industrial construction, with thorough knowledge of design drawings and specifications. Experience in steel and reinforced concrete structures and fabrication and installation of refinery piping and welding essential.

MECHANICAL ENGINEERS. University degree preferred. Refinery or chemical plant construction experience essential. Will work primarily in field under Area Engineer.

Contracts not less than 18 months. Good salary with free messing and accommodation.

Write, stating age and full particulars, to GEORGE WIMPEY & CO., LTD., Overseas personnel Office, 1, Queen Caroline Street, Hammersmith, London, W.6. R 500

A well-known firm of Management Consultants invites **APPLICATIONS FOR A PERMANENT APPOINTMENT ON ITS OPERATING STAFF.** Qualifications include a University Degree in Engineering or Science, Works training or apprenticeship and good executive experience, for preference in production. The appointment is responsible and well paid, and requires personality and ability above the average.—Please send full details to BOX R 507, Offices of ENGINEERING.

MACHINE SHOP SUPERVISOR required to take complete charge of department dealing with the production of details for Railway Rolling Stock and general work in Birmingham area. Applicants must be good organisers with wide experience, including estimating, piece price fixing, tooling and modern production methods.—Apply in writing stating age, education and experience to BOX No. 473, MUNDY, GILBERT & TROMAN, 86, New Street, Birmingham, 2. R 511

WORM GEAR TECHNICIAN required with wide experience and knowledge of Worm Gearing. Capable of supervising all machining operations in a modern industrial Gearing Shop, in the Midlands.—Write, with fullest particulars of past experience, age, and salary required, to BOX R 513, Offices of ENGINEERING.

Appointments Open continued on Page 85

Appointments Open continued from Page 84

A DRAUGHTSMAN is required by the RESEARCH LABORATORIES of THE GENERAL ELECTRIC CO., LTD., North Wembley, Middlesex, to assist in the mechanical design of microwave components. Applicants must be up to Ordinary National Certificate standard and should have had some workshop experience. If under 26 years of age, they must have completed National Service.—Apply in writing to the STAFF MANAGER (Ref. RLO/292/E), giving full details of age, qualifications and experience. R 512

DRAUGHTSMEN required for Westminster Consulting Engineer's Office, preferably with experience in plated structural steelwork and having completed National Service. Good salary and prospects for suitable applicants.—Apply BOX R 517, Offices of ENGINEERING.

GUIDED MISSILE RESEARCH AND DEVELOPMENT.

DEVELOPMENT ENGINEERS required on Guided Missile Hydro-Mechanical Devices with particular reference to control mechanisms. Laboratory Assistants also required as testers for hydraulic pumps, motors, etc.—Apply in confidence to BOX A.C.82563, SAMSON CLARK'S, 57-61, Mortimer Street, W.1. R 522

Middle East Oil Company requires **ASSISTANT POWER STATION SUPERINTENDENT,** aged under 40 and capable of operating oil or gas fired steam power station; chartered qualification and 10 years' steam power station experience. Pensionable post carrying paid home leave rights. Emoluments, for a bachelor, over £1800 p.a. For a married man, this figure would be increased.—Write, quoting No. 351, to BOX No. 6854, c/o CHARLES BARKER & SONS, LTD., 31, Budge Row, London, E.C.4. R 523

FIRST CLASS EXPERIENCED DESIGNERS of degree standard are required by a firm in South-West England for work on aircraft equipment.—Applications stating age, qualifications and experience are in the first instance to be addressed to BOX 1BB.4196, A.K. ADVG., 212a, Shaftesbury Avenue, London, W.C.2. R 527

DESIGNERS, DRAUGHTSMEN AND MODIFICATION DRAUGHTSMEN, TECHNICIANS, TECHNICAL WRITERS, TECHNICAL ILLUSTRATORS, TECHNICAL ASSISTANTS, Spares Compilers and Stressmen required for pressurising, high altitude breathing, etc.—Fully detailed applications with salary required to PERSONNEL OFFICER, NORMALAIR, LTD., Yeovil, Somerset. Local interviews arranged where convenient. R 528

Applications are invited by Industrial Consultants for vacancies on **CONSULTANT STAFF.** Essential requirements, highest technical qualifications in Mechanical Engineering and executive positions in control of production. Age 30 to 40 years. Remuneration rising from £1400 to £2000 p.a., with excellent prospects for further advancement. Chronological details of career, technical qualifications, etc., to BOX G 208, Offices of ENGINEERING.

WANTED, DESIGNER - DRAUGHTSMAN in London office of well established Company. Previous experience required in the design of High Voltage Transmission Towers, Radio Masts and other Tower-types. Higher National Certificate desirable. Excellent prospects for right man—aged 25-35.—BOX G 209, Offices of ENGINEERING.

DRAUGHTSMEN (ELECTRO-MECHANICAL AND JIG AND TOOL) required at Brentford and Feltham, Middlesex, for high-class priority work on aeronautical and marine equipment. Essential to have workshop experience, good technical knowledge and D.O. experience.

Good conditions. Pension scheme. Sports and social facilities. Single accommodation available.

Apply with full details, including salary, quoting No. 1099, to PERSONNEL MANAGER, SPERRY GYROSCOPE CO., LTD., Gt. West Road, Brentford, Middx. G 207

VICKERS-ARMSTRONGS LIMITED now in Production of Super-priority Aircraft require:
DEVELOPMENT AND PLANNING ENGINEERS.
ESTIMATORS,
RATEFIXERS and
PRODUCTION CONTROL STAFF.

Interesting work, ideal conditions with excellent Canteen and Sports Club facilities. Pension Scheme. Key workers can be recommended for housing accommodation after satisfactory probationary period.—Apply PERSONNEL DEPARTMENT, VICKERS-ARMSTRONGS, LTD., South Marston, Swindon, Wilts. R 275

JOSEPH LUCAS, LTD., who are engaged in the manufacture of electrical and other accessories for motor vehicles and aircraft of all types, and in the design, development and manufacture of gas turbine equipment, have vacancies for **QUALIFIED MECHANICAL AND ELECTRICAL ENGINEERS** for post-graduate training in their research design and development laboratories and their production and sales engineering departments, with a view to filling future executive positions in the Company. Vacancies also exist for a limited number of physicists, chemists and metallurgists.

Applications are invited from men who have a University degree in engineering or are nearing the end of their degree courses, and who have completed National Service or are about to complete it. The posts available are progressive and offer to men of character and initiative wide opportunities in the Company's many and varied activities. The Company has a staff pension scheme.

Applications should be addressed to the PERSONNEL MANAGER, JOSEPH LUCAS, LTD., Great King Street, Birmingham, and will be treated as confidential. They should be accompanied by details of age, qualifications and experience, etc. G 202

VICKERS-ARMSTRONGS, LIMITED, now in Production of Super-priority Aircraft require:
JIG AND TOOL DRAUGHTSMEN for designing machine fixtures, assembly tools and jigs.

Interesting work, ideal conditions with excellent canteen and sports club facilities. Pension scheme. Key workers can be recommended for housing accommodation after satisfactory probationary period.—Apply, PERSONNEL DEPARTMENT, VICKERS-ARMSTRONGS, LTD., South Marston, Swindon, Wilts. R 253

ENGINEER. COURTAULDS, LIMITED, require a well-qualified graduate Mechanical Engineer, with an aptitude for investigatory techniques, for its headquarters Services Department in Coventry. Applicants must have at least five years industrial background including practical experience of steam and other services plant. Age should not exceed 40.

Candidates should write for a detailed form of application to the DIRECTOR OF PERSONNEL, COURTAULDS, LIMITED, 16, St. Martin's-le-Grand, London, E.C.1, quoting the reference number B.13. R 266

HANDLEY PAGE LTD.

RADLETT RESEARCH LABORATORIES

Applications are invited for the following vacancies :—

1. **DRAUGHTSMEN** with structural steel experience for the design of test rigs.
2. **TECHNICAL ASSISTANTS** for work on electronics in connection with static and dynamic strain gauging.
3. **TECHNICAL ASSISTANTS** for general test work.

The possession of H.N.C. (Mech. or Elect.), or the equivalent, will be an advantage.

Write, stating age and full particulars, to :—STAFF OFFICER, HANDLEY PAGE, LTD., CRICKLEWOOD, LONDON, N.W.2. R 311

ENGINEERS : MECHANICAL AND ELECTRO-MECHANICAL, required at Brentford and Feltham, Middlesex, for interesting development work on aeronautical and marine products and guided missiles. Applicants must have appropriate degree or equivalent. Pension scheme—Opportunities of advancement.—Apply with full details of experience and salary required quoting No. 1098, to PERSONNEL MANAGER, SPERRY GYROSCOPE CO., LTD., Gt. West Road, Brentford, Middx. G 206

TENDERING ENGINEERS required by THE BRUSH ELECTRICAL ENGINEERING CO., LTD. A vacancy exists in the Switchgear Division for a Senior Tendering Engineer with good qualifications and commercial experience of L.T. and H.T. Switchgear up to 11 kV. There are also vacancies for Junior Tendering Engineers in the Electrical Rotating Machine Division and the Transformer Division. Applicants for these latter positions should have received a sound engineering apprenticeship, preferably with subsequent experience of the products mentioned, and be educated to H.N.C. standard. The conditions of employment are of a very high standard and include a first-rate non-contributory Pension Scheme.—Applications giving all relevant particulars, should be addressed to THE CHIEF PERSONNEL OFFICER, THE BRUSH ELECTRICAL ENGINEERING CO., LTD., Loughborough, Leics. R 389

NORMALAIR LTD. have vacancies for **DESIGN AND DETAIL DRAUGHTSMEN** in their London Office for work on Aircraft pressurisation, air conditioning and high altitude breathing equipment. Applications, stating age, experience and salary required, should be addressed to the PERSONNEL OFFICER, NORMALAIR LTD., Yeovil, Somerset. R 332

TECHNICAL REPRESENTATIVE required in London by company manufacturing a wide range of standard and special centrifugal pumps. Sound knowledge of such pumps and previous sales experience essential. Position is pensionable and offers very good prospects. Written applications, with full details of training and experience, in the first instance to MANAGING DIRECTOR, RHODES, BRYDON & YOUATT, LTD., Gorsey Mount Street, Stockport, Cheshire. R 320

FRASER & CHALMERS have a number of **VACANCIES** for **SENIOR GENERAL ENGINEERING DRAUGHTSMEN,** with structural steelwork and/or piping experience for work on Coal Washing Plant. Permanent position with good salaries for capable men. Pension scheme, Canteen facilities, five-day week.—Apply stating fully, training, experience and salary required, to PERSONNEL MANAGER, FRASER & CHALMERS, Engineering Works, Erith, Kent. R 321

DORMAN LONG & CO., LTD., require **TWO SENIOR MECHANICAL DRAUGHTSMEN** for varied and interesting work in heavy engineering in connection with a large development programme. Nominal hours, 38 per week; payment for overtime; town office and superannuation scheme in operation.—Apply stating age, experience, wage required and when at liberty to :—CHIEF TECHNICAL ENGINEER, CENTRAL ENGINEERING DEPARTMENT, DORMAN LONG AND CO., LTD., G.P.O. Box 11, Royal Exchange, Middlesbrough, Yorks. R 384

CHIEF ENGINEER required for British Managed Paper Mill in India. High calibre man with sound theoretical and practical training and experience. An Engineering Degree an advantage. Preference will be given to suitable applicants under 40 years of age. Remuneration exclusive of Company's Provident Fund Contribution approximately £2100 per annum for a four years' Agreement. Additionally free family medical attention, return passage for applicant and wife, furnished bungalow and servants provided. There are opportunities in the Organisation for promotion.—Write BOX "V.B.," c/o J. W. VICKERS & CO., LTD., 7/8, Great Winchester Street, London, E.C.2. R 392

ENGINE AND CHASSIS DESIGNERS

URGENTLY REQUIRED.

Good prospects for the right type of applicant. Salary according to age, qualifications and experience. Apply immediately to PERSONNEL MANAGER,

ROLLS - ROYCE LTD.,

PYM'S LANE, CREWE. G 181

SENIOR, INTERMEDIATE AND JUNIOR DRAUGHTSMEN required by THE ENGLISH ELECTRIC CO., LTD., Luton, for work on ground equipment associated with a Guided Weapons project. Ordinary or Higher National Certificate desirable for the more senior appointments. Experience in handling machinery problems would be an advantage for one or two of the vacancies. Houses available for suitable applicants from the Greater London Area.—Apply, quoting Ref. No. 1135, to Dept. C.P.S., 336/7, Strand, W.C.2. R 346

DRAUGHTSMAN required in London office of large engineering organisation. Full details of age, training and experience to BOX R 324, Offices of ENGINEERING.

INSTRUMENT SERVICE ENGINEER for Manchester area, with theoretical knowledge of industrial instruments and controllers and sound practical experience in their installation, commissioning and maintenance. Interview and preliminary training in London.—BOX R 374, Offices of ENGINEERING.

ASSISTANT FOREMAN for Machine and Fitting Shop required by Foundry and Engineering factory in West London. Excellent prospects for really live man with good organising ability and sound knowledge of machine shop practice. Age limit 40. Pension and bonus scheme.—BOX R 327, Offices of ENGINEERING.

A CAPABLE SENIOR COPYWRITER able to deal with technical subjects to be presented as press advertisements, catalogues, etc., is required by the Advertising Department of an engineering group in the North-West. This is a good opportunity for a man between 25 and 35 years of age who can write clear, simple English. Previous experience essential. Starting salary not less than £600 per annum and then according to ability. 5-day working week and pension scheme which the successful applicant will be expected to join.—Write details of career and salary expected to BOX R 328, Offices of ENGINEERING.

EXPERIENCED SECTION LEADER DRAUGHTSMAN required by leading centrifugal pump manufacturers in Yorkshire. Good salary and working conditions. 5-day week. Staff Pension Scheme. Canteen facilities.—Write, giving details of experience, qualifications, age and salary required, to BOX R 329, Offices of ENGINEERING.

Applications are invited for the following appointments in the Civil Engineering and Building Departments of the Steel Company of Wales Limited, Steel Division, Port Talbot.

(1) **SENIOR ENGINEER** with overall responsibility for Buildings and Steel Structures.

(2) **ASSISTANT ENGINEER** on General Building Work including Industrial and Administrative Buildings.

(3) **ASSISTANT ENGINEER** on Structural Steelwork. A sound knowledge of Electric Arc Welding essential.

The duties connected with these appointments are primarily maintenance, alterations and minor work. Practical experience and professional qualifications are essential, particularly for the Senior appointment. Salary will be commensurate with qualifications and experience. Applications in own handwriting, giving details including age, experience, qualifications, etc., should be addressed to :

THE PERSONNEL SUPERINTENDENT,
THE STEEL COMPANY OF WALES, LIMITED,
P.O. BOX NO. 3,
PORT TALBOT. R 331

LIGHT-ALLOY FOUNDRY.

Applications are invited for a **SENIOR EXECUTIVE APPOINTMENT** in an important light-alloy foundry. Applicants should be 35/45 years and at present in receipt of four-figure salary; must have wide experience in production of aluminium and magnesium castings by the most modern methods; proved administrative ability and preferably an engineering background.—BOX R 336, Offices of ENGINEERING.

SALES MANAGEMENT.

Well-known firm of light-alloy founders requires man suitable for appointment as **SALES MANAGER.** The position offers excellent prospects for a man with engineering training, commercial and sales experience and preferably first-hand knowledge of the light-alloy foundry industry and its markets.

Applications are invited from men at present earning a four-figure salary and prepared to gain experience of the company's business by an initial period of outside representation. Preferred age 30/40.—BOX R 337, Offices of ENGINEERING.

TRANSPARENT PAPER LIMITED, BURY, LANCS., have vacancies for **DEVELOPMENT ENGINEERS** aged under 30. Candidates should hold a University degree in Mechanical Engineering or equivalent qualifications, together with not less than two years' Works experience.

Applications in writing, which will be treated in confidence, should be addressed for the attention of the CHIEF ENGINEER, and give details of age, education, practical experience and salary required. R 361

LADY TRACER. Vacancy occurs in Engineering Drawing Office for Senior. Superannuation Scheme, Canteen facilities, etc.—Apply BOX R 362, Offices of ENGINEERING.

DRAUGHTSMEN. Two or Three Senior men required for work on Pulverised Fuel Equipment. General Mechanical Engineering experience would be suitable. Superannuation scheme, Sickness and Accident benefits, Canteen facilities, etc.—Apply, stating experience, etc., to BOX R 363, Offices of ENGINEERING.

THE ENGLISH ELECTRIC CO., LTD., Luton Division, require the services of a **SENIOR INSTRUMENT DESIGNER** to build up and take charge of a section for the development of accurate instrument type equipment to be used in conjunction with Guided Weapons development.—Apply, quoting ref. no. 1142, to DEPT. C.P.S., 336/7, STRAND, W.C.2. R 351

ELLIOTT BROS. (LONDON), LTD., have the following vacancy in their Aviation Division at their Rochester factory :—
MECHANICAL ENGINEER required for the development of precision instrument mechanisms, including gyroscopic devices for aviation applications. Previous experience of aircraft instruments is very desirable. Applicants should possess a degree or equivalent qualification.

Applications, quoting Ref. R.2, giving full details of age, past experience and salary expected, to PERSONNEL MANAGER, ELLIOTT BROS. (LONDON), LTD., CENTURY WORKS, LEWISHAM, S.E.13. R 352

SENIOR DRAUGHTSMAN required in South of England, convenient to London. Experienced in Mechanical and Rubber Equipment Engineering. —Details of age, experience and qualifications to BOX R 367 Offices of ENGINEERING.

DESIGNER/DRAUGHTSMAN, 20/30 years with experience of small mechanisms; H.N.C. an advantage. Company situated in Croydon area. —Please write stating age, experience, etc., to BOX R 421, Offices of ENGINEERING.

ASSISTANT CHIEF DRAUGHTSMAN required by THE STEEL COMPANY OF WALES, LIMITED, Steel Division, Port Talbot.

Applicants should provide full details of their experience and should possess technical qualifications not lower than Higher National Certificate (or equivalent) in Mechanical Engineering. The position will carry responsibilities in supervising a large body of draughtsmen and tracers on maintenance and development work.

Salary will commensurate with qualifications and experience. Applications in own handwriting, giving age and experience, should be addressed to the:—
PERSONNEL SUPERINTENDENT,
THE STEEL COMPANY OF WALES, LTD.,
P.O. BOX No. 3,
PORT TALBOT. R 353

SOUTH AFRICA.
MACHINE SHOP FOREMAN required for General Engineering Company, Port Elizabeth, undertaking light machine building to fine limits, a considerable range of general work, some marine and general repair work. Applicants must state whether single or married, number and age of children; must hold indentures 5 years apprenticeship fitter and turner, hold certificates proving technical education. Only men holding similar posts and considered suitable will be furnished with particulars of salary and agreement. Prospects are excellent for a conscientious capable man.—Applications to be made on foolscap, in own handwriting, furnishing in detailed chronological order particulars of schools, trade experience, and technical certificates gained since leaving school, with copies of credentials to BOX R 486, Offices of ENGINEERING.

MECHANICAL ENGINEER (JUNIOR) required by London Consulting Engineers. Full apprenticeship in marine or mechanical engineering, also drawing office experience essential. Knowledge of dock and harbour plant a recommendation.—Write stating age, training and experience to BOX R 483, Offices of ENGINEERING.

Application invited for **TECHNICAL ASSISTANT,** aged 23-30. Qualifications must be up to H.N.C. Required for Development Division dealing with Mechanical and Filtration problems. Design, Laboratory and Practical experience an advantage.—Applications to PERSONNEL MANAGER, VOKES, LTD., Guildford, Surrey, stating age, experience and salary required. R 484

Appointments Open continued on Page 86

Appointments Open continued from Page 85

Wanted by old-established, continuously expanding Company on Tees-side,
TWO SECTION LEADER DRAUGHTSMEN, experienced in the layout and design of Gas, Chemical, Oil Refining and similar speciality plant. Applicants should have sound knowledge of mechanical design, pressure vessels instrumentation, etc. Position also available competent Detailers. Accommodation arranged.—Apply, giving complete particulars, to BOX R 480, Offices of ENGINEERING.

ELECTRICAL ENGINEERING DRAUGHTSMAN required by Tees-side firm of engineers for the Power and Lighting installations of their various contracts. The work will include the preparation of Control Schemes, and Wiring Diagrams and Contract Requisitioning of Equipment.—Apply, stating age, experience and qualifications, to BOX R 481, Offices of ENGINEERING.

DESIGNER/DRAUGHTSMAN, Higher National Certificate standard, preferably with machine too experience, a knowledge of hydraulics and up-to-date machine tool practice, required by well-known engineering company, North-West Birmingham. Five-day week, Staff Pension Scheme, modern Drawing Office.—Apply, giving details of age, experience and salary desired, to PERSONNEL MANAGER, BOX R 482, Offices of ENGINEERING.

RAILWAY CARRIAGE AND WAGON OR DIESEL TRACTION DRAUGHTSMEN required, Staff Superannuation Scheme in operation.—Applications giving full particulars of age, experience and salary required to THE SECRETARY, THE BIRMINGHAM RAILWAY CARRIAGE AND WAGON CO., LTD., Smethwick, 40, Staffs. R 477

Old-established Tees-side Firm requires
SECTION LEADER REINFORCED CONCRETE DESIGNER/DRAUGHTSMAN, fully experienced in designing and detailing R.C. structures, foundations and other civil work. —Apply giving full particulars and experience, quoting reference "D," to BOX R 478, Offices of ENGINEERING.

TWO SECTION LEADER STRUCTURAL DRAUGHTSMEN wanted for Tees-side, capable of designing steel-framed buildings, structures, trestling, pipe bridges, etc., in conjunction with blast furnace and other heavy engineering and chemical plant. Detailers also required. Accommodation arranged.—Apply, stating full particulars, to BOX R 479, Offices of ENGINEERING.

DESIGNERS required in London area, preferably having experience in various branches of the automobile industry. Five-day week. Pension scheme, etc. Salary £750 per annum upwards according to qualifications and experience.—Applications in writing to A.E.C., LTD., Staff Records Office, Windmill Lane, Southall, Middlesex. R 464

DRAUGHTSMAN wanted for Machine Tool Makers. N.S.C. standard.—F. J. EDWARDS, LTD., 359, Euston Road, N.W.1. EUSton 4681. R 468

YOUNG ENGINEER required for training by Somerset firm producing centrifugal pumps and electric motors. Applicants should be good mathematicians with sound basic knowledge of hydraulics and preferably some electrical design knowledge. Salary in accordance with qualifications. Interview London. State fullest particulars of training and experience.—BOX R 472, Offices of ENGINEERING.

ASSISTANT FOUNDRY MANAGER required in West of Scotland for modern steel foundry operating Electric Furnaces. Applicants should have sound experience of Electric Furnace Melting Plant practice.—Replies, giving full particulars of experience and qualifications, to BOX R 474, Offices of ENGINEERING.

A senior vacancy exists with a large industrial organisation in the West End of London for a fully qualified
HEATING AND VENTILATING ENGINEER, capable of preparing initial designs, layouts, specifications and obtaining tenders, etc., for new works, alterations and extensions to existing works. The appointment is permanent and pensionable, and carries an attractive salary. Applicants should be between 30-45.—Please reply giving full details of age, experience, etc., to BOX A.M.7877, A.K. ADVG., 212a, Shaftesbury Avenue, London, W.C.2. R 462

MECHANICAL ENGINEER required at Southall for design and development work connected with civil engineering plant and associated equipment. Applicants should have a thorough technical training and practical experience in this field. A knowledge of general engineering and layout of mechanical equipment would be an advantage. Staff pension scheme and good working condition. Salary in accordance with experience and qualifications.—Apply DR. MURDOCK, GEORGE WIMPEY AND CO., LTD., Central Laboratory, Lancaster Road, Southall, Middlesex. R 463

DRAUGHTSMAN required with sound practical workshop and Drawing Office experience. Must possess at least Ordinary National Certificate in Engineering. Knowledge of both batch and jobbing production methods desirable. Successful applicants will be required for design of Grinding and Mixing Machinery. Good scope for initiative. Staff Pension Scheme. Salary according to age, qualifications, experience and ability.—Apply in writing, giving full particulars, to CHIEF DRAUGHTSMAN, TORRANCE & SONS, LTD., Bitton, Bristol. R 492

DESIGN ENGINEER required, U.S.A. University Graduate with experience power transmission clutches and bellows expansion pipe-joints. Age 30-40. Salary 500 dollars per month.—BOX R 493, Offices of ENGINEERING.

Applications are invited for a post as
CIVIL ENGINEER for initiating and supervising civil engineering and structural work. Applicants should be Corporate Members of the Institution of Civil Engineers or of the Institute of Structural Engineers. Salary will be dependent upon experience and qualifications and will be within the range £785-£1235.

Applications, giving particulars of age, education, experience and qualifications, together with copies of two recent references to be sent not later than JULY 11th, 1953, to the AREA ADMINISTRATIVE OFFICER, NATIONAL COAL BOARD, N.E. Division, Area No. 2, St. George's, Thorne Road, Doncaster. R 488

A large industrial organisation has a vacancy for an
ELECTRICAL DRAUGHTSMAN at their Head Office in London. Some knowledge of electrical circuits for power and lighting installations and electrical plant layout in factories is desired, also the theory connected with such installations. Age 22-26.—Reply in the first instance stating education, age, experience, and salary required to BOX A.M.7871, A.K. ADVG., 212a, Shaftesbury Avenue, London, W.C.2. R 461

THE MOTOR INDUSTRY RESEARCH ASSOCIATION.

Applications are invited for the following posts :—
RESEARCH ENGINEER. Good Honours Degree essential :—

(*a*) For general automobile engineering problems, experience of experimental stress analysis and/or problems associated with brakes an advantage.
(*b*) For investigations concerning mechanical properties—in particular fatigue strength—of materials and components.
(*c*) For investigations into loadings experienced by vehicle components on the road, riding characteristics of vehicles, etc. (This position would be suitable for a mechanical engineer with good knowledge of electronics, or an electronic engineer with interest in mechanical engineering.)

Salaries in the range £500-£700 depending on age and experience, with Superannuation under the F.S.S.U. It may be possible to make housing accommodation available within a reasonable period. —Reply in writing, giving age, qualifications and experience in detail to THE DIRECTOR, MOTOR INDUSTRY RESEARCH ASSOCIATION, Lindley, Nuneaton, Warwickshire. R 487

SERVICE MANAGER. A vacancy will arise in six months time for the position of Service Manager with a leading north country firm manufacturing an extensive range of earth-moving and agricultural equipment. Applications are invited from qualified personnel able to undertake the technical administration of an expanding department, and co-operate with Works and Design. Knowledge of Diesel engines, earthmoving equipment and some overseas experience desirable. Salary according to qualifications.—Write with full details of previous experience to BOX R 433, Offices of ENGINEERING.

CEYLON.
European-controlled Company requires
MECHANICAL ENGINEER preferably unmarried, aged 26-30, with sound practical knowledge of horizontal and vertical diesel engines, pumps, general machinery installation and repair work ; estimating and sales experience would be an advantage. The post offers an attractive salary, local cost of living allowance, medical expenses and provident fund.—Application should be made in own handwriting and give full details of age, training, qualifications and experience to BOX N.858, WILLING'S, 362, Grays Inn Road, London, W.C.1. R 429

COST REDUCTION ENGINEER required by well-known firm of Management Consultants, headquarters in London, now expanding its consultancy staff and requiring first-class Engineer capable of undertaking operations which will lead to reduction and control of costs through the application of production methods, jig and tool design, plant layout, time and motion study and bonus incentive schemes. Applicants must have a wide experience of industry and an outstanding ability in executive/administrative positions to meet the above requirements.—Applications detailing age, qualifications, training, experience, salary required to BOX R 457, Offices of ENGINEERING.

ASSISTANT MECHANICAL MAINTENANCE ENGINEER required for organisation in East London district operating large electrical station. Applicants should have wide and up-to-date experience in the maintenance of modern generating station power plant and be capable of supervising turbine and boiler overhauls. Technical qualifications should be sound. Age not less than 32 or over 45. Commencing salary £950 per annum with non-contributory pension. Position has excellent prospects.—Reply to BOX R 431, Offices of ENGINEERING, quoting REFERENCE TME/6.

Chain manufacturers require
ENGINEER with varied experience on specialised equipment to control maintenance of plant and production of small chains for the jewellery trade, write giving full particulars of past experience and salary required.—P.M.C. CHAINS, LTD., Shortlands, London, W.6. R 438

IMPERIAL CHEMICAL INDUSTRIES LIMITED,
Plastics Division, requires a
DRAUGHTSMAN for work on the instrumentation of chemical and plastics plants. Candidates should possess the HIGHER NATIONAL CERTIFICATE in Mechanical Engineering and should have had previous experience in this type of work. Salary according to age and qualifications. Staff Pension Fund. Five-day 39-hour week.—Write for application form to the STAFF MANAGER, I.C.I., LTD., PLASTICS DIVISION, Black Fan Road, Welwyn Garden City, Herts. R 441

A large manufacturing organisation with factories throughout Britain requires at their Head Office, London, a
JUNIOR PLANNING ENGINEER. Applicant should have a good University Degree, and have held positions dealing with design, development and installations of chemical plants including practical works experience.—Write giving full details of age, experience and qualifications to Box A. M.7804, A.K. ADVG., 212a, Shaftesbury Avenue, London, W.C.2. R 442

MECHANICAL INSPECTING ENGINEER for services in this country or South Africa. Applicants should be 26/40 years and hold qualifications such as degree in Mechanical Engineering, A.M.I.Mech.E. or H.N.C. Fully experienced in design and manufacture of water tube boilers, steam turbines and all ancillary equipment required for power stations. With knowledge of welding, metallurgy, and non-destructive testing. M.O.T. First-Class Steam Endorsement an advantage. A period of training will be given to suitable applicant. Salary according to age and experience.—Write BOX R 454, Offices of ENGINEERING.

DRAUGHTSMEN with experience in Machine Design or Plant Layout required.—Applications giving full particulars should be addressed to E.M.A., CADBURY BROTHERS, LTD., Bournville, Birmingham. R 456

YOUNG ENGINEER, about 24, required to train for responsible position in mass production factory in Croydon, starting as junior assistant to Managing Director. B.Sc. or equivalent essential, coupled with workshop training. Whitworth Scholar or prizeman preferred. Must show proof of being one of top three in several subjects. Salary about £700 per annum to commence.—BOX R 446, Offices of ENGINEERING.

DRAUGHTSMAN for progressive department designing equipment for treating air and gases. H.N.C. standard required with experience of structural and sheet metal work. Pressure vessel and/or electrical knowledge an advantage. Good salary and conditions.—Apply in writing to PERSONNEL OFFICER, BIRLEC LIMITED, Tyburn Road, Erdington, Birmingham, 24. R 448

MOTION STUDY ENGINEER required for large mass production precision engineering works in East Midlands for study of work handling and methods problems associated with production throughout the works. Experience of motion study essential and time study knowledge desirable. The Company is old established and operates a pension scheme. Assistance given with housing accommodation.—Reply stating age, particulars of experience and salary required to BOX R 452, Offices of ENGINEERING.

Vacancies for
MECHANICAL DRAUGHTSMEN exist with the Research and Development group of a major Industrial Company in the West End of London. Experience of chemical plants desirable but not essential. Initial salary according to experience and qualifications.—Reply giving full details of age and experience to the BRITISH OXYGEN CO., LTD., Bridgewater House, Cleveland Row, St. James's, S.W.1. R 443

A rather exceptional opportunity exists with a major Industrial Organisation for
ENGINEERS. Applicants should be aged 22-27 and hold a degree in Mechanical Engineering. Applicants should preferably have 1-2 years Industrial experience. These posts carry very good salaries and offer excellent prospects.—Reply giving full details of age, qualifications and experience to Box A. M.7786, A.K. ADVG., 212a, Shaftesbury Avenue, London, W.C.2. R 444

TECHNICAL MANAGER required to take charge of small Drawing Office to control co-ordination with production, and initiate design and development. Preferably experienced in the automatic weighing and packaging industries, or comparable precision mechanisms, and with electrical knowledge. —State age, education and experience, with salary required, to BOX R 445, Offices of ENGINEERING.

ENGINEER. Opportunity for keen well educated young man. Good Shop experience and Draughtsmanship essential. Able to put his own ideas on paper. Location Birmingham. State age, qualifications and salary expected.—BOX R 434, Offices of ENGINEERING.

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Good Prospects and Attractive Working Conditions
Apply, stating age, experience and salary expected to SECRETARY, ALVIS LTD., COVENTRY
R 510

Classified Advertisements continued on Page 87

Classified Advertisements continued from Page 86

MACHINERY FOR SALE.

DICKINSON HORIZONTAL BORING, MILLING, DRILLING AND TAPPING MACHINES, dia. of spindle 3 in. Motorised.
ATLAS HORIZONTAL BORING, MILLING, DRILLING AND TAPPING MACHINES, dia. of spindle 3¼ in. Motorised.
KEARNS FLOOR TYPE HORIZONTAL BORING AND DRILLING MACHINE, No. 7 Morse taper spindle. Motorised. Weight 17 tons.

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600

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4500-C.F.M. REAVELL, vert., 2 crank, 4-cyl., watercooled, speed 290 r.p.m., forced feed lubrication to main bearings, automatic lubrication to cylinders. Direct coupled 300-h.p. totally encl. S.R. Induction Motor by L.D.C., 400/3/50. Pressure 7/10 lb. Alternatively 4300 c.f. at 20 lb. pressure.

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NEW BESCO KSF.13 UNIVERSAL PUNCH, SHEAR AND NOTCHING MACHINE. Steel plate construction, on truck, motor driven. Shears plates up to ½ in., flats 2½ in. by ¾ in., angles and tees 90 deg., 3 in. by 3 in. by ¾ in. and on the mitre 2½ in. by 2½ in. by ⅝ in., rounds 1⅛ in. and squares 1¼ in. Punches ¾ in. dia. by ½ in. plate. Notches ⅛ in. thick. Full details available.
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AVERY 691 BRINELL HARDNESS TESTER. Capacity 3,000 k.g. Table 5 in. dia. Throat 5¾ in. Maximum daylight 9 in.
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FOR SALE.

PRACTICALLY NEW 526 CU. FT. HOLMAN MOTOR-DRIVEN AIR COMPRESSOR SET, type TM60S, on Bedplate, direct coupled to 120-h.p. C.P. Slip Ring Motor. Low price for quick sale.—Apply : G. E. SIMM (MACHINERY) LTD., East Parade Chambers, Sheffield, 1. R 313

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UNUSED DANKS SELF-CONTAINED ECONOMIC BOILER, 100 lbs. working pressure ; complete with fittings and mountings, forced-draught equipment, chimney, feed pumps, tank, piping, etc.
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Tel. : Llandaff 95. R 319

FOR SALE.

ONE NO. 2½ "BLISS" INCLINABLE POWER PRESS, Geared type, 4 in. stroke, motorised, complete with Shear Pin Device and Interlock Guards. Unused.
ONE NO. 21B "BLISS" INCLINABLE POWER PRESS, as above but 3 in. stroke. In use for 9 months only.
Can be inspected by appointment.
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HORIZONTAL THREE-THROW HYDRAULIC PUMPS, by Davy United, stainless steel rams 3½ in. dia. by 15 in. stroke, approx. 54 g.p.m., 1 ton p.s.i. pressure, driven through double helical gearing.
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IMMEDIATE DELIVERY AND USE.
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COMPLETE 6000 LB. PER HOUR, 140 P.S.I. STEAM GENERATING PLANT, consisting of 14 ft. by 8 ft. Brick Set Horizontal Multitubular Boiler by Wilson Boiler Co., fitted with I.D. and F.D. fans, and Meldrum sprinkler stoker. The plant also includes a Hotwell, two 4 in. by 6 in. by 7 in. Weir vertical feed pumps, and a brand new steel chimney with guy ropes, etc. Situated at Edinburgh. Price ex-works £6000 or near offer.—Reply to BOX R 470, Offices of ENGINEERING.

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HEAVY DUTY
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Swing over bed ..	22⅞ in.
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Speed range	9·6-480 r.p.m.

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Spindle bore	4½ in.
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Swing over cross slide ..	13 in.
Speed range	9·6-480 r.p.m.

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Spindle bore	6 in.
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Speed range	6-300 r.p.m.

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G 229

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Loco. and other types of Cranes in stock.
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ONE CROMPTON PARKINSON SENTINEL DIESEL GENERATOR SET in Brand-new condition, Alternator 75 kVA, 400/440 volts A.C., 3-phase, 50 cycles, 103 amps. continuous rating. This set is a complete unit mounted on skids and has electric starting complete with batteries.—Reply to BOX R 435, Offices of ENGINEERING.

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PATENTS.

THE PROPRIETORS OF PATENT NO. 588091 FOR "IRREVERSIBLE TRANSMISSION" desire to secure commercial exploitation by Licence or otherwise in the United Kingdom.—Replies to HASELTINE LAKE & CO., 28, SOUTHAMPTON BUILDINGS, CHANCERY LANE, LONDON, W.C.2. R 378

THE PROPRIETOR OF BRITISH PATENT NO. 617278 for "IMPROVEMENTS IN MAXIMUM SAFE AIR SPEED INDICATORS FOR AIRCRAFT AND THE LIKE," desires to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder. —Further particulars may be obtained from MARKS AND CLERK, 57 and 58, Lincoln's Inn Fields, London, W.C.2. R 450

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THE PROPRIETORS OF BRITISH PATENTS NOS. 616070 AND 618470, for "Improvements in or Relating to Chucks," are desirous of arranging by way of licence or otherwise for the commercial development of the invention in this country.—Enquiries to BARON & WARREN, 16, Kensington Square, London, W.8. R 516

CAPACITY AVAILABLE.

DESIGN OFFICE CAPACITY available for General Mechanical and Production Engineering, Special Machines or Projects. — NORRIS BROTHERS, Perrymount Chambers, Haywards Heath, Sussex. Tel. : H. Heath 1669. G 212

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MANUFACTURING CAPACITY REQUIRED for fabricated metal assemblies in sheet and section, weight 30 lb. Batches 50-500.—MAN-BUILD, LTD., 171, Victoria Street, London, S.W.1. R 497

Classified Advertisements continued on Page 88

Classified Advertisements continued from Page 87

COMPANY MEETING.

THE A.P.V. COMPANY.

CHANGED TRADING CONDITIONS.

[LARGE POTENTIAL DEMAND].

The forty-third ordinary general meeting of The A.P.V. Company, Limited, was held on June 18 in London, Dr. Richard J. S. Seligman, Ph.Nat.D., F.C.G.I., F.Inst.Met., F.I.M. (the chairman), presiding.

The following is an extract from his circulated statement :—

The consolidated net profit of the Group, before providing for taxation, amounted to £378,261 for the year ended December 31, 1952, of which £327,426 was attributable to the Parent Company and £50,835 to the Subsidiaries. Trading conditions generally became much more difficult during the second half of 1952, with the result that there was a downward trend in selling prices compared with the earlier years of the post-war period, in which a sellers' market prevailed. These changed conditions greatly affected the earnings of your Foundries, which also suffered from the disturbance caused by moving to the new Crawley factory.

Provision for taxation in the Group accounts required £189,727, which is almost exactly 50 per cent. of the profit. Your Board recommends the payment of a final dividend of 7d. per share, which makes a total distribution of 10 per cent. to the Ordinary Shareholders.

Current assets amounted to £4,441,549, being £2,002,440 in excess of current liabilities.

In examining, last year, the prospects of your Company for the coming year, I drew your attention to the threat to its welfare offered by the change from a sellers' to a buyers' market and concluded my remarks on this subject by the statement that a considerable period of difficulty for your Company must be envisaged. As you will have seen from the accounts, this warning was justified. Your directors still feel, however, that these adverse factors are not likely to persist, at any rate in their present intensity. They have evidence that large demands exist for plant and equipment which your Company is particularly fitted to supply and that it is only necessary for the obstacles and restrictions to be lifted for a resumption of buying to take place ; perhaps not on the intense or even excessive scale of the first post-war years but sufficient, at any rate, to ensure a satisfactory turnover for your Company.

Part of your new factory at Crawley came into full operation at the beginning of this year.

This marks the completion of Stage 1 of your Company's move to Crawley, but it leaves very important parts of its manufacturing facilities and its head office at Wandsworth. The grave handicap of this continuing division of both works and offices is, if anything, even more evident than was anticipated and it seems quite certain that the full benefit which your Directors expected and expect from the move to Crawley cannot be realised until after the completion of Stage 2, which is planned for the end of 1954.

Your Board has, therefore, decided that the necessary finance should be obtained, and for this purpose an Extraordinary Meeting of Shareholders will be held immediately after the forthcoming Annual General Meeting, when a Resolution creating additional Preference Shares will be submitted.

I am again able to report that all your eight Subsidiary Companies worked profitably in 1952. Trading profits were, however, reduced chiefly due to the trade recession which occurred in the foundry industry during the year under review.

FUTURE PROSPECTS

Your directors believe that with the heavy backlog of orders brought forward from 1952, and the contracts being placed with your Company during this year, the invoiced sales position for 1953 will be satisfactory if no unforeseen circumstances occur. Your Company will then be in a position to take full advantage of the revival of its normal markets. In the meantime a large part of your Company's manufacturing facilities are being devoted to furthering the Government's rearmament plans and, unless there is a sudden change in these, your directors are given to understand that these activities on your Company's part are likely to be maintained and even increased. At the same time your scientific and technical staffs are directing their attention to longer-range developments which, your directors are of the opinion, will enable your Company to cater for certain well defined needs of several of the industries it serves.

The report was adopted. R 459

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STORAGE AND OFFICE SPACE TO LET, 8000 sq. ft. Rent 3s. per sq. ft. All ground floor, excellent main road position, central heating, many entrances.—Apply CAMDEN (KENT) INVESTMENT CO., LTD. GERrard 1394. R 496

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Telegrams : Russonken, Manchester. G 59

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WANTED, WASTE MERCURY, Aircraft Sparking Plugs, Contacts, Points and Scrap Materials containing Gold, Silver, Platinum. Forward samples; immediate attention ; also non-ferrous scrap.—BELGRAVE BUYERS (Eg), 5, Belgrave Gardens, London, N.W.8. MAI. 7513. R 294

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GOOD SECONDHAND 6-TON OVERHEAD ELECTRIC MAGNET CRANE, span 72 ft., lift 18 ft. Electric 440/3/50. Crane gantry for above crane 350 ft. long.—BOX R 495, Offices of ENGINEERING.

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Trays are tapered from 7in. width to front, forming semi-circle when interlocked

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DESIGN No4

ENGINE INDICATOR

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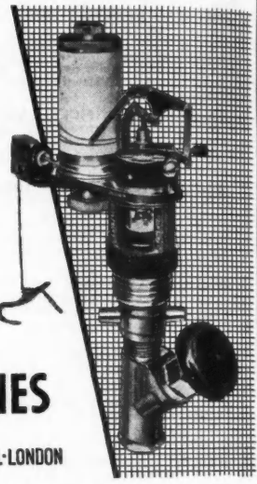
The principal results of these improvements are—larger and more accurate diagrams at higher engine speeds—repairs are simplified and the indicator is easier to use.

The No. 4 Indicator is fitted with spare cylinders and pistons of various cross-sectional areas the instrument is suitable for Steam and Diesel work.



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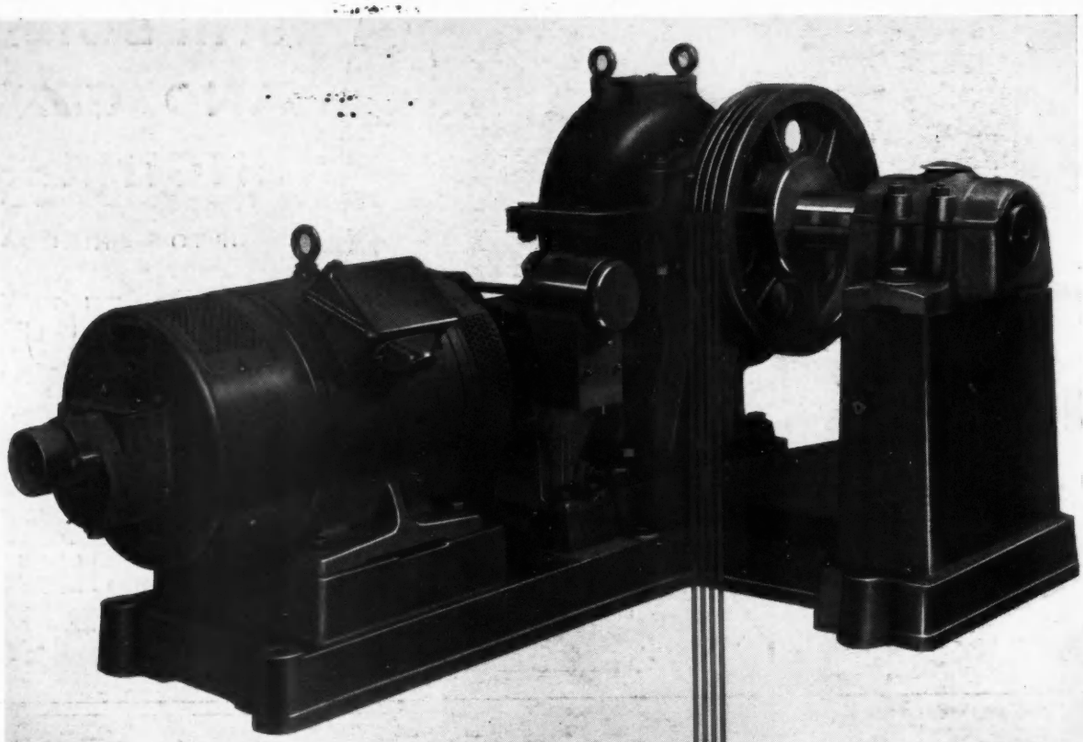

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